INFORMATION TECHNOLOGY CHOICES BY CONSUMERS AND FIRMS

by

Han-fen Hu

A dissertation submitted to the faculty of
The University of Utah
in partial fulfillment of the requirements for the degree of

Doctor of Philosophy

in

Business Administration

David Eccles School of Business

The University of Utah

August 2012

The University of Utah Graduate School

STATEMENT OF DISSERTATION APPROVAL

The dissertation of **Han-fen Hu**

has been approved by the following supervisory committee members:

Paul Hu	, Chair	**6/12/2012** Date Approved
Olivia R. Liu Sheng	, Member	**6/12/2012** Date Approved
Vandana Ramachandran	, Member	**6/12/2012** Date Approved
Xiao Fang	, Member	**6/12/2012** Date Approved
William L. Moore	, Member	**6/12/2012** Date Approved

and by **William Hesterly**, Associate Dean of the **David Eccles School of Business**

and by Charles A. Wight, Dean of The Graduate School.

ABSTRACT

This dissertation consists of three essays that investigate the general decision process of users' choices regarding information technology (IT) applications and products, focusing on placebo effects of software pricing, incorporating user perceptions and product attributes in modeling software product choices, and firms' practices of green IT. Taking a customer-centric approach to users' assessments of IT applications and products, I address the evaluative responses of individual consumers and organizations to market information including price, product attributes, and key contextual factors.

The objective of the first essay is to understand the placebo-like effects invoked by the price of software products on consumers' satisfaction, problem-solving performance, and purchasing behavior. Built upon the response expectancy theory, a research framework and a series of hypotheses are proposed. I test the hypotheses with a controlled experiment, and the data supports most of the hypotheses. Specifically, a user's outcome expectancy, as activated by software price, affects not only his/her satisfaction, but also the problem-solving performance using the software product. Satisfaction and actual problem-solving performance in turn affects the user's willingness-to-pay.

In order to better explain and predict consumers' preferential choices of software products, I propose in the second essay a model that incorporates product attributes and consumer perceptions to estimate users' software product selection. The influences of product attributes on users' perceptions of product characteristics are also examined. With a choice-based conjoint study, and the collection of additional data on users' perceived

product characteristics, I demonstrate that the proposed model can better explain and predict users' software choices than the model with product attributes only, or with user perceptions only, in terms of the in-sample fit and the holdout prediction hit rate at the individual-level and the aggregate-level.

The third essay examines important drivers of green IT practices by firms. I propose a framework premised on social contracts theory and institutional theory, and then use it to develop a model that explains firms' decisions. I test the model and the associated hypotheses with the survey data collected from 304 major firms in Taiwan. Overall, the results show global environmental awareness, industry norms, and key stakeholders' attitudes affect a firm's green IT practices directly. Competitors seem to play a limited role, as suggested by an insignificant impact on the firm's green IT practices.

TABLE OF CONTENTS

LIST OF FIGURES

Figures

LIST OF TABLES

Tables

ACKNOWLEDGEMENTS

I would never have been able to finish my dissertation without the guidance of my committee members, help from friends, and the support from my family and husband.

First and foremost, I would like to express my deepest gratitude to my advisor Dr. Paul Hu. I appreciate all his contributions of time, ideas, and funding to make my degree possible. The enthusiasm he has for research is motivational to me. It was only with his continued support, positive attitude, and great direction that I was able to complete my degree. I would like to thank Dr. Olivia Sheng, for her excellent guidance, caring and patience. Her good advice and support have been invaluable on both an academic and a personal level, for which I am extremely grateful. I would also like to thank Dr. Bill Moore for guiding my research and helping me to develop my background in marketing, that I extensively applied in my research. I am also grateful for his encouragement and support, and the excellent example he has provided as a successful researcher and professor. Thanks to Dr. Vandana Ramachandran and Dr. Xiao Fang who were willing to participate on my supervisory committee. I appreciate their time and the valuable suggestions for my research.

I would like to thank Yang Zhou, Iljoo Kim and Chong Oh, who as my cohorts in the program were always willing to help and give their best suggestions.

The love of family provided my inspiration and was my driving force. Special thanks to my mother, Dan Hsu, for raising me with an appreciation for education and being willing for so long to help me obtain this goal. I would also like to remember and

acknowledge the support of my late father, Chao-feng Hu. Thanks too, to my aunt, Shiu-ching Hsu and my brothers, Chih-yiao and Chih-kuei Hu for believing in me and for their love and encouragement. Thanks to my loving, supportive, encouraging, and patient husband I-jen Yen. He was always there cheering me on and standing by me. His faithful support during the final stages of this Ph.D. is so appreciated.

CHAPTER 1

INTRODUCTION

Technology purchasing decisions represent complex processes that have attracted substantial attention from both researchers and managers. Individual consumers often make choices about software products with varying relative strengths and limitations, on the basis of key characteristics, such as price, functionality, user interface design, and vendor support. For organizations, technology choice decisions tend to involve broader strategic considerations, such as strategic orientation, and the contextual factors of the technology usage. Thus vendors must understand the key factors affecting choice by consumers and organizations, and then leverage that knowledge to improve their product design and marketing communication.

To approach this broad research question, I examine the influence of the three fundamental aspects of decision-making: external market information, the decision context, and internal information process strategies. Specifically, I focus on the placebo effects of software pricing, incorporating user perceptions and product attributes in modeling software product choices, and firms' practices of green information technology (IT). My customer-centric approach to users' assessments of IT applications and products differs from prior studies that tend to focus on vendors' profit maximization or product differentiation. Instead, I address the evaluative responses of individual consumers and

organizations—in the form of product evaluations, purchase decisions, preferential choices and adoption decisions—to market information including price, product attributes, and key contextual drivers.

My first essay conjectures that product price may create placebo-like effects which could enhance user satisfaction and purchase intention. Price is a critical marketing tool for delivering product signals. Customers tend to expect a positive correlation between price and quality, and price thus, can signal quality. This price–quality relationship is often implicit and unconscious, yet, still can exert placebo-like effects on product evaluations. I investigate these placebo-like effects on consumer satisfaction, problem-solving performance, and purchasing behaviors. To better understand the underlying mechanisms, I focus on a trial consumption setting that involves a software product, and investigate the influences of consumer expectancy and motivation. This essay includes a controlled experiment as an empirical test of the influences of price placebo-like effects on customers' perceptional and behavioral outcomes.

Consumers' software choices also warrant further conceptual analysis and empirical testing. The second essay posits that product attributes manipulated by software vendors can affect users' product preferences, both directly and indirectly through perceptions. With a wide range of software to choose from, end users often find the purchase of packaged software a complex decision process; the process consumers use to select from product alternatives have been of interest to researchers and managers alike. I examine the influences of observable product attributes and perceived characteristics on consumers' software product choices by considering key factors that affect purchase decision-making, using a choice experiment and conjoint analysis that models

preferences and the potential trade-offs across different product attributes or perceived characteristics. Specifically, I address the following questions: Is it possible to explain consumers' packaged software preferences better using choice models and conjoint analyses that include both product attributes and consumer-perceived characteristics, rather than one or the other?

The third essay examines important drivers of green IT practices by firms. Specifically, I examine the influence of contextual factors at different levels on firms' green IT practices. I propose a framework premised on social contracts theory and institutional theory, and then use it to develop a model that explains firms' decisions. I test the model and the associated hypotheses with survey data collected from 304 major manufacturing and service firms in Taiwan. The data supports the model and most of the hypotheses it suggests. Overall, the results show global environmental awareness, industry norms, and key stakeholders' attitudes affect a firm's green IT practices directly. Global environmental awareness indirectly influences firms' green IT practices via industry norms; so do laws and government regulations, though their direct effects appear statistically insignificant. Competitors seem to play a limited role, as suggested by an insignificant impact on the firm's green IT practices.

CHAPTER 2

PLACEBO-LIKE EFFECTS OF MARKETING INFORMATION

Introduction

Software is a multi-billion dollar global industry (BSA, 2009) and one of the fastest growing sectors worldwide (Gallaugher & Wang, 2002). The pricing decision of software products is therefore critical. A handful of studies have examined software pricing strategies by focusing on profit maximization or product differentiation through versioning and bundling; e.g., Bhargava and Choudhary (2001); and Gallaugher and Wang (2002). The effects of price on consumers' product evaluations and purchase behaviors are also essential to software pricing but have not yet received due attention.

Price is a critical marketing tool for delivering important signals to consumers. For example, many consumers have been found to use price as a proxy of product quality, and rely on it to make purchasing decisions, particularly when product quality cannot be observed easily or directly before consumption; e.g., experienced goods (Gerstner, 1985; Grewal, Monroe, & Krishnan, 1998; Rao, 2005). Because of the consumer's tendency to expect a positive correlation between price and quality, price can be used for quality signaling. Prior research examining the effects of price on consumer behaviors suggest that price, as an essential cue, shapes consumer expectations that in turn affect perceived quality (Almenberg & Dreber, 2010), intrinsic benefits (e.g., pleasantness; Plassmann,

O'Doherty, Shiv, & Rangel, 2008), or even the actual efficacy consumers gain from a product (Shiv, Carmon, & Ariely, 2005a). In situations where product price does not correlate to actual quality, consumers' beliefs about the price-quality relationship may still have important anchoring effects on their experience with the product (Shiv et al., 2005a). Such expectations premised in the price-quality relationship, usually implicit and unconscious, can induce "placebo-like" effects on consumers' product evaluations and purchasing decisions.

A placebo is a substance or procedure that has no intrinsic power to produce an effect that is sought or expected (Stewart-Williams & Podd, 2004). Example placebos include a sugar pill, a treatment procedure, a brand name, a store name, a place (such as the country of origin), or a price. Shapiro and Shapiro (1984) define a placebo *effect* as "the psychological or psychophysiological effect produced by placebos" (p. 372). Placebo effects have been studied in health care settings that include psychology; marketing researchers also have investigated similar effects associated with consumer goods (Rao, 2005). For example, the product price can make consumers perceive the product quality differently, and induce changes in consumers' psychological and/or physical states (Shiv et al., 2005a). Specifically, price can create placebo effects.

The focus of this study is to investigate the price placebo effect on software products. Most corporations and individuals depend on computer software for accurate and timely information, as well as effective information processing (Krishnan, Kriebel, Kekre, & Mukhopadhyay, 2000). Its growing scale also makes the software industry significant to the world economy (Gallaugher & Wang, 2002). In addition, software product features can vary greatly as compared to features of other consumer products or

industrial goods, and warrant further examination of the previous research results which were based on consumer products. Software products are information goods and therefore, differ from tangible consumer products in cost structure, quality observability, purchase frequency, and market information asymmetry. The zero (or negligible) marginal cost of reproduction common to software products (Gallaugher & Wang, 2002) allows vendors to better leverage different pricing strategies, such as subsidies, versioning, and trialability, as compared with vendors of tangible goods (Bakos & Brynjolfsson, 1999; Gallaugher & Wang, 2002). Software products are experience (credence) goods (Chellappa & Shivendu, 2005); the quality of a software product, usually, is not easily and directly observable by consumers. In general, consumers have difficulty describing, measuring, and making adequate references to the quality of information goods (Chellappa & Shivendu, 2005; Takeyama, 2009) and need to rely on other external cues, such as price, to make quality judgments. Thus, I expect the price of a software product to play an essential role in consumers' product evaluations. In this vein, it is essential to examine consumers' evaluations and purchase behaviors of software products in the context of probable price placebo effects.

While most previous studies examining price placebo effects seem to focus on the impacts on consumers' evaluations of a product or service, this study examines probable price placebo effects on actual problem-solving performance (i.e., efficacy consumers gain from a software product) and purchase behaviors (i.e., the amount of willing-to-pay). Although consumers generally, are willing to pay for products of high (perceived) quality or those which provide high efficacy gains, the relationship between price placebo effects and purchase behaviors is crucial and warrant thorough scrutiny.

Prior placebo research emphasizes consumers' expectancies and motivations as the underlining mechanism of placebo effects (Hyland & Whalley, 2008; Price & Fields, 1997). Toward that end, Shiv et al., (2005a) suggest consumers' expectations of a placebo leads to the placebo effect, whereas Irmak, Block, & Fitzsimons (2005) show that the consumer's desire of achieving a goal also determines the placebo effect. Some other psychosomatic studies in turn recommend the inclusion of both expectancy and motivation in explaining placebo effects (Jensen & Karoly, 1991; Hyland & Whalley, 2008). In the context of price placebo effect, I posit that the consumer's motivation to achieve a goal and a compatible expectation of the placebo jointly leads to the placebo effect, with motivation playing a moderating role in enhancing the influence of the consumer's expectancy on the placebo effect. When a consumer holds a motivation to achieve a placebo-compatible goal, the motivation would direct his/her cognitive processing and behavior toward confirming the expectation of a placebo (Geers, Weiland, Helfer, Kosbab, & Landry, 2005). That is, consumers' expectancy of the placebo leads to the placebo effect, and the motivation of achieving the goal would enhance consumers' desire of confirming the expectancy.

Overall, this research is concerned with the placebo effects invoked by the price of software products on consumers' satisfaction, problem-solving performance, and purchase behavior in a trial consumption setting. I also investigate the influences of consumers' expectancy and motivation in order to better understand the underlying mechanism of price placebo effect in the context of software products. Specifically, I address the following questions:

1. Does an individual's expectancy of a software product activated by its price affect his/her product evaluation, problem-solving performance with that product, and the purchase behavior?

2. Are the impacts of an individuals' expectancy on product evaluation and problem-solving performance moderated by an individual's motivation to use the product?

By examining price placebo effects on users' problem-solving performance when using a software product, I contribute to extant literature by expanding the boundary of placebo effects from the previously reported physical and psychological conditions (including mental acuity) associated with tangible products and healthcare services to behavioral outcomes associated with information goods. Second, by examining price placebo effects on consumers' purchasing decision, I advance the existing literature by showing a placebo can not only change consumers' perceptions, but also may influence their economic activity; i.e., purchasing behavior. Third, by showing motivations to be another important factor affecting placebo effects, this research sheds light in the underlying mechanism of price placebo effects. The study also helps software providers make more informed pricing decisions, from a customer-oriented perspective, toward optimal pricing.

Literature Review

This study relates to several streams of research, including software pricing and the placebo effect; I provide overviews in this section. I also review prior research investigating users' assessment of software products in particular to highlight my motivation.

Software Pricing

As technology continues to advance at a breathtaking speed, theories and management practices seem to fall behind in providing clear guidance regarding how information (digital) goods should be packaged, priced, and sold (Bakos & Brynjolfsson, 1999; Chen & Png, 2003). Information goods have several special characteristics that make their pricing especially challenging. Regarding costs, information goods have high fixed costs and near-zero marginal costs; cost-based pricing is not appropriate for information goods (Bakos & Brynjolfsson, 1999; Rautio, Anttila, & Tuominen, 2007; Tiwana & Ramesh, 2001). On the other hand, value-based pricing is based on the value recognized by target users (Nagle & Holden, 2002); however, the value of information goods is relatively difficult to observe, and the users' perceived value of a software product is affected by a set of factors requiring more research (Rautio et al., 2007).

Previous research that examines software pricing seems to focus on factors germane to the supply-side considerations, such as product line design (e.g., Bhargava & Choudhary, 2001), versioning and bundling (e.g., Clements & Northrop, 2001), cost structure (e.g., Jorgensen & Shepperd, 2007; Haruvy & Prasad, 2001), and piracy prevention (e.g., Sundararajan, 2004b). Many studies investigate optimal pricing for profit maximization, analytically or empirically (e.g., Brynjolfsson & Kemerer, 1996; Sundararajan, 2004a), and produce results suggesting a positive relationship between price and market share (Gallaugher & Wang, 2002) and a negative correlation between price and piracy (Gopal & Sanders, 2000; Khouja & Park, 2007). Price also has been

identified as an important factor for IT product diffusion (Tam, 1996). The collective findings suggest the viability of strategic use of product pricing for increased profits.

Placebo Effects

Placebo effects are frequently observed in health care, in which a placebo can yield therapeutic benefits perceived by patients because they expect that the medication prescribed by their doctors should work (Rao, 2005). Similar effects are also observed with general consumers. For example, a placebo might be a product that claims to have appealing properties or desirable functionalities, through which consumers' product assessments or behaviors may change (Irmak et al., 2005). Placebos have been shown to change patients' conditions or recovery (Lanotte, Lopiano, Torre, Bergamasco, Colloca, & Benedetti, 2005), people's feelings (O'Boyle, Binns, & Sumner, 1994) and mental acuity (Shiv et al., 2005a), or even neural mechanisms (Plassmann et al., 2008). They are shown to affect consumers' perceptions about product quality (e.g., Almenberg & Dreber, 2010) and physical performance (Shiv et al., 2005a).

Among various marketing actions (such as the design and execution of promotion, product, pricing, and channel) that can induce placebo effects, price arguably is the factor most studied, partly because price is an important attribute of products/services and constitutes an essential element of a firm's marketing strategy. Although price is not an attribute intrinsic to a product, consumers can easily relate its relationship to product quality (Shiv, Carmon, & Ariely, 2005b), based on the conventional wisdom that high-quality products in general are more expensive to produce than those of low quality.

Price placebo effects influence consumers' perceptions, product evaluations (such as taste; Almenberg & Dreber, 2010), and neural mechanisms (Plassmann et al., 2008). For example, Shiv et al., (2005a) investigate the effects of product price on the efficacy gain consumers have by consuming a product, and report noticeable placebo effects. By manipulating the price of a product, they observe that price influences consumers' expectations and then affects the actual efficacy they gain from the product. Their findings provide an interesting perspective of the price-quality relationship with empirical evidence suggesting that perceptions do influence reality.

Users' Assessment of Software Products

Consumers' assessments of software products represent another important consideration for software pricing. Although different from most software pricing research that focuses on market-level analyses, this stream of research emphasizes individual consumers' perceptions of important characteristics of software products (such as perceived usefulness, perceived ease of use; Davis, 1989; Davis, Bagozzi, & Warshaw, 1989), the organizational context (e.g., subjective norms, perceived behavioral control; Ajzen & Madden, 1986; peer influence, compatibility; Chau & Hu, 2002), and individual users (such as experience, attitude; Venkatesh, Morris, Davis, & Davis, 2003). Other studies examine the effects of users' needs (e.g., Lucas, Walton, & Ginzberg, 1998) or the informational cascade (e.g., Duan, Gu, & Whinston, 2009). Together, these studies highlight the important influences of consumers' evaluations of software products before consumption.

Among the different measurements of consumer product evaluations, user satisfaction seems to be critical, as it manifests a consumer's overall assessment of a software product (Bailey & Pearson, 1983; Doll & Torkzadeh, 1988). In general, user satisfaction refers to the overall feelings or affective attitude of an individual about a product, service or information system (DeLone & McLean, 1992; Doll & Torkzadeh, 1988; Muylle, Moenaert, & Despontin, 2004). User satisfaction is particularly important in end-user centric settings because it emphases an individual's direct interactions with a product or service towards accomplishing his/her goal. In the context of evaluating a software product, it captures a person's assessment and appreciation of a software product and the utilities the product produces (Bailey & Pearson, 1983).

The software assessment research provides a theoretical foundation for users' purchase behavior studies; users assess a software product based on their interactive experience with the software, and to what extent the software can effectively help users to solve problems. Therefore, a user's overall, perceptual assessment of a software product plays a critical role in his/her product purchasing decisions, and need to be taken into consideration.

Gap Analysis and Motivation

The literature review suggests several gaps to be addressed. First, software pricing has been studied primarily from the perspective of IS economics – important behavioral issues surrounding consumers' product evaluation deserves more research attention. Many studies examine pricing strategies at a macro level analytically or empirically, often with key assumptions about market conditions, such as social welfare, market

equilibrium, or externality. While producing important results and insights about optimal pricing strategies, these studies do not address issues specific to consumers, such as how they react to prices. It is therefore, essential to investigate the effects of price on customers' product evaluations and purchasing decisions, including their willingness-to-pay. By doing so, the study can generate insights for software pricing strategies that consider the behavioral aspects of consumers.

Although prior studies have empirically tested the general process of placebo effects induced by marketing actions, consumer goods seem to be a common focus (Irmak et al., 2005). Despite the placebo effects found in various health care and marketing contexts, it remains unclear how a software product's price would affect people's expectancy and their problem-solving performance with the product. While consumer products and medications can be easily consumed by the users, and may directly change the consumers' conditions, software packages are used as tools that may require certain knowledge or capability before they can be used effectively, and the software packages are not supposed to alter the users' physical conditions. In addition, consumers usually have less referencing information for software product quality (e.g., none or few physical components that can be observed; Tiwana & Ramesh, 2001). Thus, we expect that the probable price placebo effects may differ between software products and the consumer goods previously studied. Therefore, it is essential to examine whether the price of information goods (such as software products) can induce placebo effects on consumers' product evaluations and actual performance.

Changes of consumers' evaluations and conditions (physical or mental) have been investigated by previous research examining placebo effects (Rao, 2005; Shiv et al.,

2005a; Irmak et al., 2005). Whether or not consumers are willing to purchase a product that has positive placebo effects has not been studied. For example, it is important to examine whether the presence of desirable placebo effects would make consumers more willing to pay a higher price for a software product. For business managers, consumers' purchasing decisions are critical and constitute the ultimate goal of all marketing actions that include pricing. In addition, user satisfaction is essential to consumers' purchasing decision. This factor has been studied by prior IS research extensively, often in the context of technology implementation or user acceptance. However, price-related outcomes of user satisfaction (such as willingness-to-pay) have often been neglected in previous research (Homburg, Koschate, & Hoyer, 2005). The role of user satisfaction in consumers' purchasing decisions remains unclear, particularly in the presence of price placebo effects.

Theoretical Foundation and Framework

In order to address the research questions, I develop a framework built upon the response expectancy theory (Kirsch, 1997). According to the response expectancy theory, beliefs about a substance can activate expectations for a particular effect, which then influence the effectiveness of the substance, perceived or actual. People choose to perform a behavior on the basis of their expected results of that behavior (Oliver, 1974). Expectancy could affect the outcome of a behavior (Shiv et al., 2005a); it may be activated by beliefs intrinsic and extrinsic to a product. For example, beliefs may be activated by external cues directly or indirectly (Shiv et al., 2005b). The presented substance or treatment constitutes an external cue that can anchor a person's beliefs,

which activates expectancy of the results (outcomes) of consuming the substance or receiving the treatment. In turn, the resulting expectancy leads to observable or measurable outcomes, and hereby creates placebo effects (Shiv et al., 2005a).

In light of response expectancy theory, product price can serve as an important external cue activating consumers' expectancy of product quality, through their belief about the price-quality relationship. The underlying rationale is that a high priced product may reflect superior quality or be associated with a high production cost (Gerstner, 1985). This belief, implicit perhaps, renders a logical basis for consumers' use of price as a product quality indicator (Gerstner, 1985), which is a cognitively efficient process (Rao, 2005). The use of price as an important cue for estimating product quality has ample empirical support (Rao, 2005). For example, Grewal et al., (1998) show the advertised reference price to affect consumers' internal reference price directly and their willingness-to-buy indirectly.

Motivation to experience the benefits of a product also plays an important role in price placebo effects (Rao, 2005; Geers et al., 2005; Irmak et al., 2005). The motivation relates to a person's drive to perform a behavior in order to achieve specific goals, such as receiving a reward or avoiding a penalty (Vallerand, 1997). Motivations are instrumental for consumers' evaluation of information technology, including software products (Venkatesh, 2000).

As shown in Figure 2.1, the framework depicts the process associated with price placebo effects. When a consumer receives an external cue, his/her salient beliefs about the external cue would activate a corresponding expectancy, or anticipation of the consequences of using the focal product. The expectancy then leads to perceptional and

behavioral outcomes, or placebo effects. In addition, the consumer's motivation for using the product, which is independent of the external cue, also plays a key role in changing the price placebo outcomes. When the consumer is motivated to use the product, the effects of expectancy on the outcome would be enhanced, because the consumer's motivation of achieving the goal would increase his/her desire to confirm the expectancy. The outcome, or the placebo effect, can be perceptional and subject to the consumers' personal experience of product consumption; the outcome can also be behavioral that can be assessed by objective measurements.

Research Model and Hypotheses

I derive a research model based on the conceptual framework and include additional factors of interest to examine the effect of price on users' evaluation and the actual performance outcome of using a software product.

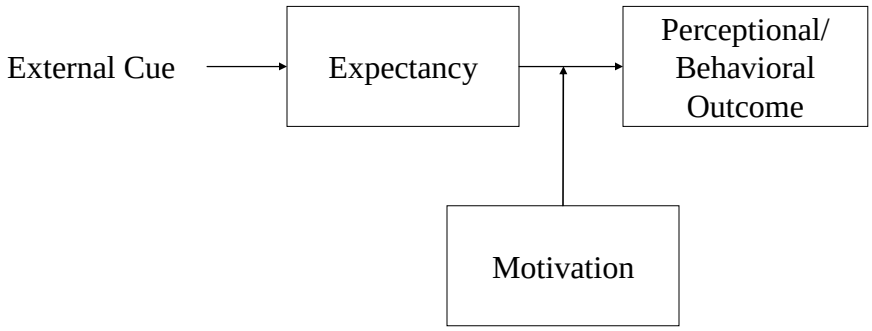

Figure 2.1. Research Framework of the Price Placebo Effect Study

As shown in Figure 2.2, price serves as the external cue to activate consumers' expectancy of product quality, based on their salient belief of the positive correlation between price and quality. The motivation of using the software product enhances consumers' tendency to confirm their expectancy of the outcome. In the context of this study, users are motivated to perform well in using a software product to solve problems by monetary incentives.

The research model includes the perceptional and behavioral outcomes by focusing on consumers' overall product evaluation, actual problem-solving performance, and the ultimate purchasing decision. Users' satisfaction captures users' overall experience of using the software, which is based on users' perceptional judgment. The possible relationship of the perceptional and behavioral outcome is also examined. Specifically, satisfaction is shaped by both the expectation and the actual outcome, and the purchasing

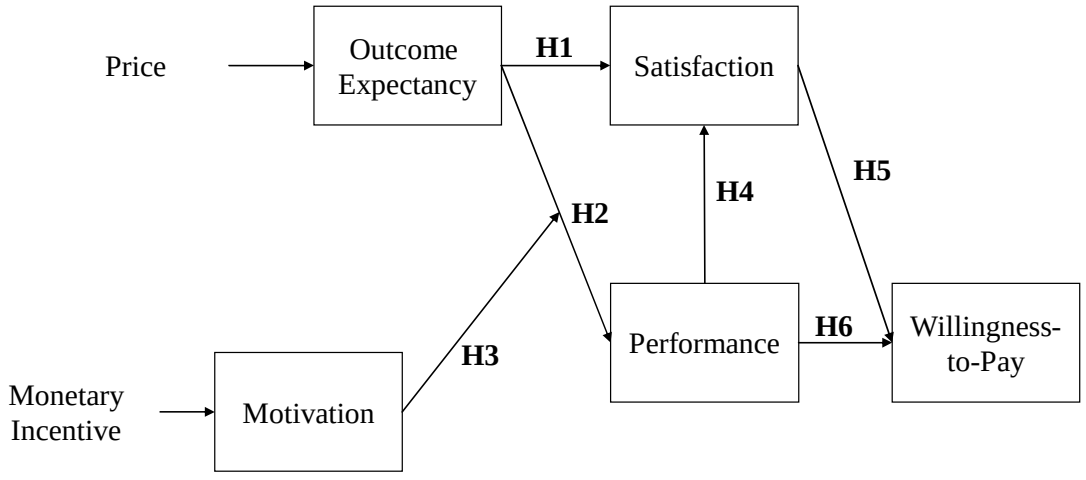

Figure 2.2. Research Model of the Price Placebo Effect Study

decision is determined by both satisfaction and problem-solving performance. These relationships are important to both researchers and practitioners, because price is a key element in the profit equation and directly links to profitability for the software vendors (Homburg et al., 2005).

According to response expectancy theory (Kirsch, 1997), when a person receives an active substance or a treatment (i.e., price of a product in this study), his/her salient belief about the substance activates expectancy of the consequences of using the substance or being treated (Shiv et al., 2005a). A majority of the placebo effect studies employed the expectancy approach to explain the placebo effect: anticipations that a treatment will result in a particular outcome (Geers et al., 2005; Kirsch, 1999). According to this view, price placebo effects are one type of expectancy effect, and therefore the higher the users' expectancy of the quality, the higher their satisfaction with the software product.

H1: The level of a user's outcome expectancy of the software product quality is positively associated with the users' satisfaction with the software product.

From the self-efficacy perspective, a user's behavioral outcome can be shaped by self-efficacy beliefs (Kirsch, 1985). That is, when a user holds a belief about his/her ability to achieve a certain result, the behavioral outcome would be more likely to confirm the belief. In addition, the self-efficacy belief can also be influenced by external cues, such as price (Shiv et al., 2005a). In the context of this study, the expectancy of software product performance or quality stimulated by the product price is likely to influence the user's ability to successfully solve decision-making problems using the software product. It would in turn affect the users' belief about his/her ability of solving

decision-making problems with the assistance of the software product, and this self-efficacy belief would positively affect the behavioral outcome. Prior studies also provide empirical evidence that price-related self-efficacy beliefs are the most salient factors affecting consumers' physical performance outcomes (Shiv et al., 2005a).

The outcome variable, problem-solving performance, is related to the user's mental condition or intellectual abilities, which might differ widely from physical conditions studied in prior research. However, self-efficacy beliefs lie and arise "within the individual," and the effects of self-efficacy beliefs are not limited to physical conditions (Kirsch, 1985). Thus, I hypothesize a user's expectancy of the product quality would positively affect his/her behavioral outcome.

H2: The level of a user's outcome expectancy of the software product quality is positively associated with his/her problem-solving performance using the software product.

Motivation of using a product to achieve a certain goal plays an important role in placebo effects, and has been recognized as a main driver of placebo effects (Rao, 2005; Geers et al., 2005; Irmak et al., 2005). When a consumer is motivated to make use of a software product, the consumer tends to spend more effort and persistence in completing the tasks, and therefore is more likely to achieve the desirable outcome (Wigfield & Eccles, 2000). Achievement motivation theorists also argue that individuals' task performance can be explained by their beliefs about how well they will do on the activity and the extent to which they value the activity (Atkinson, 1957; Wigfield & Eccles, 2000) that involves both expectancy (i.e., self-belief of the outcome) and motivation (i.e., the value of the activity they recognize). The expectancy-value model of achievement

motivation specifically suggests expectancy and motivation would influence effort, persistence and task performance (Eccles, Adler, Futterman, Goff, Kaczala, Meece, & Midgley, 1983). In this line of reasoning, the relationship between outcome expectancy and users' task performance would be enhanced when the user is highly motivated. Thus, I propose the following hypothesis:

H3: The level of a user's motivation of using a software product moderates the positive relationship between the user's expectancy and his/her problem-solving performance using the software product.

According to the satisfaction literature, users' product evaluations are jointly determined by their expectation and the actual outcome (McKinney, Yoon, & Zahedi, 2002; Oliver, 1980). The confirmation or disconfirmation between expectation and the outcome determines the level of satisfaction; if the expectation is not confirmed by actual experience, the discrepancy, in terms of direction and magnitude, determines customer satisfaction (Li & Hitt, 2010; McKinney et al., 2002). In the context of this study, if a person's belief of the price-quality correlation is not confirmed by actual experience, a high price may have a negative effect on his/her satisfaction.

In addition, if a user performs well in the problem-solving processes, he/she gains high efficacy from using the software to solve problems. From a utilitarian's perspective, the user would have a positive attitude toward the software product since he/she gains benefits from using the software. Thus, the problem-solving performance of using the software would positively associate with the users' satisfaction with the software product.

H4: A user's problem-solving performance using a software product is positively associated with his/her satisfaction with the software product.

The relationship between user satisfaction and willingness-to-pay can be explained by the equity theory (Adams, 1965). Equity theory suggests that parties to an exchange perceive equitable treatment if the ratio of their outcomes to inputs is in some sense fair (distributive justice). Therefore, when a customer perceives a high level of satisfaction, he/she receives positive outcome from the product, and therefore is willing to pay more for the product because this results in an equitable ratio of outcome to input and maintains a sense of fairness (Bolton & Lemon, 1999). Similarly, when satisfaction is low, customers perceive a low payment as adequate to establish a fair exchange. Prior study also empirically reveals the strong, positive impact of customer satisfaction on willingness-to-pay (Homburg et al., 2005).

H5: A user's satisfaction with a software product is positively associated with his/her willingness-to-pay for the software product.

Value is the worth to a customer of satisfying benefits they seek from the product (Smith & Nagle, 2002). Furthermore, value can be determined objectively (the value that buyers actually receive) or subjectively (the value buyers perceive they receive) (Smith & Nagle, 2002). For a software product designed to help users solve problems, task performance serves as a direct, and probably objective, indicator for users to determine the value of the product. Thus, when users perform better in solving problems with the software product, they would be willing to pay more for the product as an equity exchange (Homburg et al., 2005).

In addition, a prior study has suggested that users' willingness-to-pay is positively related to their value consciousness; i.e., when users can better recognize the value of a software product, they are willing to pay a high price for the product (Hsu & Shiue,

2008). The task performance of using a software product to solve problems is directly observable and can be easily recognized by users, and therefore can increase their value recognition. In this line of reasoning, users with better task performance would tend to pay a high price for the software product. Thus, I propose the following hypothesis:

H6: A user's problem-solving performance using a software product is positively associated with his/her willingness-to-pay for the software product.

Experimental Design and Data Collection

I conducted a controlled experiment to test the hypothesized relationships. By manipulating the price of a software product and users' motivation level, I seek to measure users' satisfaction and actual task performance of using comparable software of different prices. In the experiment, I measure users' satisfaction to capture their overall feelings or affective attitude about the software product, and capture users' behavioral outcomes by assessing the effectiveness for users to solve a problem with the help of the software product. I also control for users' ability of using computers and other demographics. At the end of the experiment, the willingness-to-pay is also measured, to capture users' final purchasing decision. The study design is detailed as follows.

Experimental Design

In this experiment, I used a 2 (price: $99.99 versus $3.99) by 2 (monetary incentive: present vs. absent) between-subjects design. In this controlled experiment, I asked participants to evaluate a software product by using it and indicating his/her satisfaction with the software product, and willingness-to-pay. I controlled for product type in the

experiment; specifically, I used a particular spreadsheet product. The spreadsheet package used in the experiment is As-Easy-As Spreadsheet, a standalone spreadsheet package under freeware license.

The participants are undergraduate students who enroll in the Computer Essentials course. The important subject selection criteria are their baseline knowledge of spreadsheet software (i.e., a qualified participant has to use any spreadsheet software in the past 6 months for class assignment or work tasks), and no prior experience with As-Easy-As Spreadsheet, the focal software package used in this study. I asked each participant to self-report his/her experience of using spreadsheet software (Yes/No), whether they have used or heard about As-Easy-As Spreadsheet (Yes/No) and how many times they used any spreadsheet package in the past 6 months, to validate that a spreadsheet package was familiar to the participant.

The decision problems were prepared based on students' course work and the review of basic spreadsheet package functions. I summarized the basic spreadsheet functionalities and categorized those related to numeric calculations as statistical, operational, mathematical, and financial. The experiment tasks were then designed around these functions. For each of the tasks, if a specific concept and formula is needed for calculating the results, I provided the definition, explanation and formula in the task description. In the pilot study, I examined the appropriateness and complexity of the tasks, and measured the average time of solving the problems. Each of the problems on average took the participants approximately one minute to get the results. The decision problem is described in Appendix A.

Experimental Flow

This study was conducted at a designated laboratory. Before each experimental session, I used a script to explicitly inform the subjects of the study's purpose and procedure, and specifically addressed concerns about information privacy and ensured subjects that all data analyses would be performed at an aggregate level, not in any personally identifiable manner. At the beginning of the session, participants were informed that as part of the study, they would be asked to evaluate a spreadsheet product. A demonstration of the spreadsheet functionalities was provided. They were then asked to provide background information (i.e., gender, age, major, and software expenditure in the past 12 months) and answer questions regarding their computer abilities. Next, the price of the spreadsheet package ($99.99 or $3.99, according to the experimental condition they are in) was shown to the participants, together with some other dummy information, such as name of vendor, version, etc. Next, the participants were asked questions about expectancy.

Two warm-up exercises similar to the experimental tasks were given to the participants. The participants could repeat the exercise until they were ready for the experiment. Precipitants then solved seven problems using the spreadsheet package. The problems were shown on the screen, and the participants needed to enter the answers into the system. Subsequently the participants were asked to respond to the measures of their satisfaction with the focal software product and their willingness-to-pay for the software. I also asked participants to recall the price of the software product they had been given, and reveal their perceived motivation during the experiment. The study flow is shown in Figure 2.3.

All subjects were presented with the experimental tasks following an identical sequence, namely, starting with tasks of low complexity and progressing to those of high complexity.

Measurements

The expectancy is measured by three items adopted from Shiv et al. (2005a). Users' satisfaction is measured by four items from Au et al. (2008). I also include users' computer ability as a control variable which is measured by a six-item scale adapted from the Computing Ability Scale (CAS; Kay, 1993). All of above measurements employ a seven-point Likert scale with 1 being "strongly disagree" and 7 being "strongly agree."

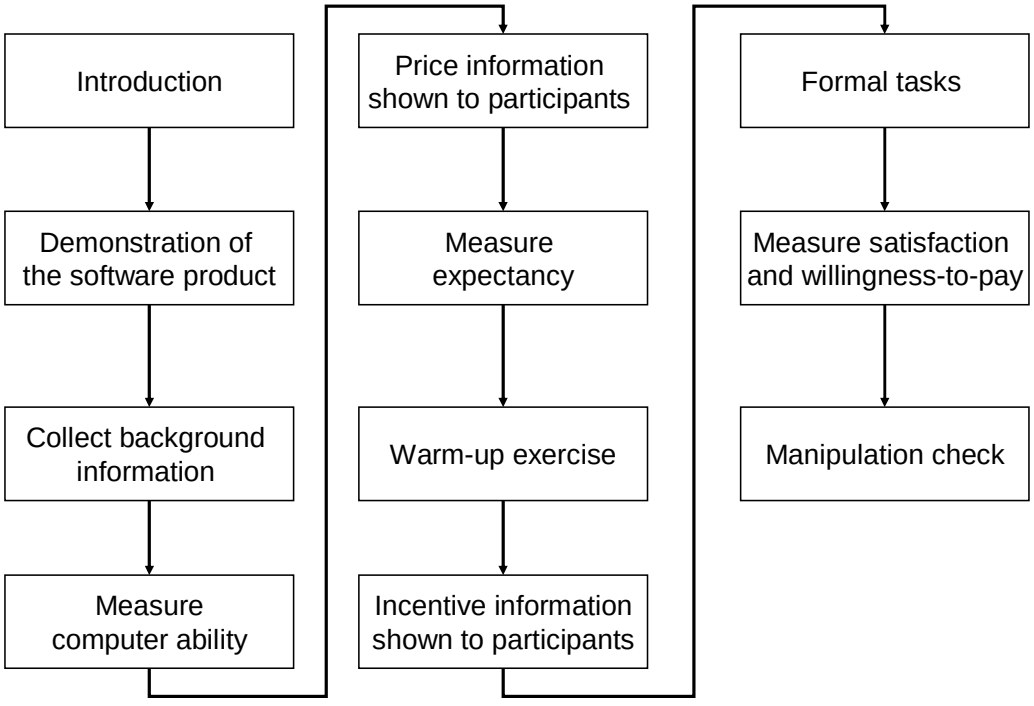

Figure 2.3. Study Flow of the Price Placebo Effect Study

In order to measure the problem-solving performance of using the software product, the correctness of the participants' answers to the decision problems is calculated; i.e., the number of problems correctly solved. I measured the participants' willingness-to-pay by providing 10 small price ranges for respondents to choose from. The question items included in this study are listed in the Appendix B.

Data Analysis and Results

Pilot Study

Before the main experiment, I conducted a pilot study to assess participants' performance and the measurement reliability and validity. I also assessed whether the complexity of the problems was appropriate for the targeted participants. For the pilot study, I used 30 participants from the same population as that of the main experiment. The procedure also closely followed the one I used in the main experiment.

The results of the pilot study show that the participants can correctly solve 3.9 out of 7 problems (standard deviation = 1.35), which shows that my measurements have satisfactory reliability and validity, as discussed below.

Main Experiment

Altogether, 135 participants took part in the study. Among them, 105 subjects, or 80.6% of the participants, could correctly recall the retail price of the software shown at the beginning of the experiment. After removing some invalid data points (i.e.,

participants who ignored the price information, or failed the screening task[1]), 99 data points are used in the subsequent analysis. The participants were randomly assigned to the four experiment conditions; i.e., 22 to 27 participants in each condition (see Table 2.1).

Manipulation Check. Results of the manipulation check indicated that the mean of the average expectancy score of the low price group is 4.85 and that of the high price group is 5.55. The mean difference between the two groups is significant ($t = 4.52$; $p < 0.001$). The mean of the motivation score of the low incentive group is 4.43 and that of the high incentive group is 5.47. The mean difference between the two groups is significant again ($t = 3.72$; $p < 0.001$). The results suggest that the manipulation of expectancy and motivation is successfully induced.

Measurements. I examined the instrument in terms of its reliability and convergent validity. I analyzed the instrument's construct reliability by examining internal consistency, using Cronbach's alphas. Each construct attained a Cronbach's alpha value greater than 0.7, suggesting appropriate internal consistency (Nunnally, 1978), as shown in Table 2.2.

Table 2.1. Numbers of Participants in the Experiment Conditions

	High Price	Low Price
Incentive	27	27
No Incentive	22	23

[1] I used the first problem, which asked for the mean of a series of numbers, as the screening task, to screen out participants who did not spend sufficient effort in the study.

Table 2.2. Summary of the Measurements

	Cronbach's Alpha	**Mean**	**Std. Dev.**
Expectancy	0.88	5.26	1.11
Satisfaction	0.97	5.19	0.87
Computing Ability	0.89	4.29	1.65

I further examined convergent and discriminant validity by checking the cross-loadings computed from the correlation between each construct's component score and the manifest indicators of other constructs (Chin, 1998). As the results in Table 2.3 show, all the items loaded substantially higher on their own construct than on other constructs. Overall, our results confirm that the instrument possesses appropriate construct reliability and validity.

Table 2.3. Summary of Factor Loadings of the Price Placebo Effect Study

	Expectancy	Satisfaction	Computing Ability
Exp-1	**0.62**	0.05	0.32
Exp-2	**0.78**	0.31	0.03
Exp-3	**0.77**	0.24	0.03
Exp-4	**0.67**	-0.10	0.24
Exp-5	**0.81**	0.17	0.03
Exp-6	**0.84**	0.17	-0.03
SF-1	0.26	**0.90**	-0.07
SF-2	0.18	**0.94**	0.01
SF-3	0.12	**0.93**	-0.11
SF-4	0.11	**0.95**	-0.05
CA-1	0.17	-0.04	**0.79**
CA-2	0.23	-0.03	**0.79**
CA-3	0.04	-0.03	**0.84**
CA-4	0.09	0.00	**0.81**
CA-5	-0.04	-0.03	**0.85**
CA-6	0.05	-0.12	**0.77**

Hypotheses Testing. Due to the unequal numbers in each condition, I applied the regression approach to test the hypotheses. Table 2.4 shows the results of regression analysis on user satisfaction. Outcome expectancy and task performance are positively correlated with users' satisfaction with the software product, with computer ability controlled. The results support H1 and H4. Users' task performance is measured by the task correctness. As shown in Table 2.5, task performance is positively correlated with outcome expectancy and the level of motivation. However, the interaction effect of expectancy and motivation is not significant. Thus, H2 is supported, but not H3. Finally, users' willingness-to-pay is positively associated with users' satisfaction and task performance, as shown in Table 2.6. The results support both H5 and H6.

In sum, the results show outcome expectance as induced by software price have positive effects on users' satisfaction with the software product, and users' task performance of using the product to solve problems. Although motivation can enhance users' task performance, the moderating effect of motivation is not significant. Satisfaction and the task performance together affect users' willingness-to-pay for the product. The hypotheses testing results is summarized in Table 2.7.

Discussion

The study results provide support for the perceptual and behavioral placebo effects of software pricing. Specifically, users perceive a higher level of satisfaction with a more highly-priced software product, and also perform better in solving problems using the product, compared to a lower-priced, comparable product. User satisfaction is enhanced

Table 2.4. Summary of Regression Analysis Results (Dependent Variable: Satisfaction)

R-square	0.236			
Adjusted R-square	0.194			
	Beta	Std. Err	T	Sig.
(Constant)	0.49	1.35	0.36	0.72
Outcome Expectancy	0.63	0.18	3.56	0.00
Task Performance	0.31	0.10	3.16	0.00
Computer Ability	-0.26	0.13	-1.99	0.05
Age	0.01	0.03	0.22	0.83
Gender	0.35	0.30	1.14	0.26

Table 2.5. Summary of Regression Analysis Results

(Dependent Variable: Task Correctness)

R-square	0.314				0.319			
Adjusted R-square	0.278				0.274			
	Beta	Std. Err	t	Sig.	Beta	Std. Err	t	Sig.
(Constant)	0.09	1.23	0.07	0.95	0.54	1.38	0.39	0.69
Outcome Expectancy	0.32	0.16	2.03	0.05	0.22	0.20	1.08	0.28
Motivation	1.57	0.27	5.94	0.00	0.37	1.65	0.22	0.83
Expectancy * Motivation					0.23	0.31	0.74	0.46
Computer Ability	0.03	0.12	0.26	0.80	0.04	0.12	0.33	0.74
Age	0.05	0.03	1.64	0.10	0.05	0.03	1.64	0.10
Gender	0.00	0.27	0.01	0.99	0.00	0.27	-0.01	1.00

Table 2.6. Summary of Regression Analysis Results

(Dependent Variable: Willingness-to-pay)

R-square	0.274			
Adjusted R-square	0.218			
	Beta	Std. Err	t	Sig.
(Constant)	-0.30	0.94	-0.32	0.75
Satisfaction	0.39	0.08	5.03	0.00
Task Performance	-0.20	0.09	-2.31	0.02
Computer Ability	0.17	0.10	1.61	0.11
Age	0.01	0.03	0.39	0.70
Gender	0.16	0.25	0.63	0.53
Software Spending	0.07	0.04	1.83	0.07

Table 2.7. Summary of Hypotheses Testing Results of the Price Placebo Effect Study

	Hypotheses	Results
H1	The level of a user's outcome expectancy of the software product quality is positively associated with the users' satisfaction with the software product.	Supported
H2	The level of a user's outcome expectancy of the software product quality is positively associated with his/her problem-solving performance using the software product.	Supported
H3	The level of a user's motivation of using a software product moderates the positive relationship between the user's expectancy and his/her problem-solving performance using the software product.	Not Supported
H4	A user's problem-solving performance using a software product is positively associated with his/her satisfaction with the software product.	Supported
H5	A user's satisfaction with a software product is positively associated with his/her willingness-to-pay for the software product.	Supported
H6	A user's problem-solving performance of using a software product is positively associated with his/her willingness-to-pay for the software product.	Supported

by users' outcome expectancy, as well as the task performance. This result is consistent with the literature that suggests the confirmation between expectation and actual performance leads to user satisfaction (McKinney et al., 2002; Oliver, 1980). Therefore, product price can affect users' perceptual outcome with the product (i.e., satisfaction) both directly and indirectly through behavioral outcome (i.e., task performance).

In addition, the effects of motivation and expectancy on task performance are significant, which is consistent with the expectancy-value model (Eccles et al., 1983). However, the interaction effect of expectancy and motivation is not supported by the empirical results. It indicates that users' task performance can be driven by their outcome expectancy, no matter the level of motivation to experience the outcome. That is, even if a user does not have explicit motivation to use a software product, he/she can still

experience positive outcomes led by a high level of expectancy triggered by price. This result further highlights the importance of price placebo effects.

The results also provide empirical support for the positive effects of user satisfaction and task performance on users' willingness-to-pay. It echoes the value-based pricing approach for information goods. When users can objectively or subjectively recognize the value of a software product, they are willing to pay a high price for the product. Since there is little quality referencing information for an information good, users make their purchasing decision or determine their willingness to pay based on their value recognition of the product.

These findings offer several implications for research. First, software pricing can be studied not only at a macro level from the economics perspective, but also at the micro level from the user behavior perspective. While the IS economics research analyzes the market changes induced by various pricing strategies, the direct influence of software pricing on users' purchasing behavior cannot be ignored. Since consumers are not always rational actors on the market, their perceptions and direct reactions to product price can be very different from what is predicted by economic theories. Second, although there is no direct evidence showing that a software product can alter a users' physical or mental condition, the results of this study demonstrate the price placebo effect in increasing users' task performance. An information good cannot be "consumed" by the users, but it can still activate the mechanism that leads to placebo effects. While the boundary of the placebo effect has been extended from the tangible goods to intangible goods, future research efforts can be devoted to this research stream to further identify the possible application of such placebo effects. Third, the study results show that the placebo effect

can lead to changes in users' willingness-to-pay, which can directly affect the software products' profitability. Thus, this study suggests future analyses of a new product's profitability can also take the price placebo effect into consideration in order to better estimate the results.

For practitioners, this study also offers some important implications. First, in the decision of the pricing strategies, the price placebo effects need to be included. Although the price placebo effect may only exist in the market in which users do not have sufficient information for quality judgment (e.g., new product entrance), users' early experience can also affect the product introduction outcome by generating positive user reviews and network externality. Software vendors need to carefully decide their pricing strategy in light of the price placebo effect. Second, it is confirmed that user satisfaction and high task performance would lead to a high willingness-to-pay. It enhanced the importance of a good software design that can provide direct benefits to users. The findings from this study should help software providers make more informed pricing decisions, particularly with a customer-oriented perspective.

Conclusion

This study aims at an understanding of the placebo effects invoked by the price of software products on consumers' satisfaction, problem-solving performance, and purchase behavior. Built upon the response expectancy theory, a research framework is proposed, which consequently suggests a series of hypotheses. I test the hypotheses with a controlled experiment, and the data supports most of the hypotheses. Specifically, a user's outcome expectancy, as activated by software price affects not only his/her

satisfaction, but also the problem-solving performance using the software product. Satisfaction and actual problem-solving performance in turn affect the user's willingness-to-pay. However, users' motivation to use a software product does not moderate the relationship between the user's expectancy and the problem-solving performance.

By examining the placebo effects of marketing information on consumers' problem-solving performance, I contribute to extant literature by expanding the boundaries of placebo effects beyond physical and psychological conditions to behavioral outcomes that actually increase user efficacy. This study also extends the placebo effects associated with tangible products or healthcare services to those associated with information goods. This study advances our knowledge about placebos, which are known to change consumers' perceptions. This study shows that placebos can lead to changes in users' purchasing behaviors. Furthermore, the study results suggest that the price placebo effect is driven by outcome expectancy, but not users' motivations. The empirical evidence shows that motivations do not moderate the influences of expectancy on product evaluation and problem-solving performance; it sheds light on the underlying mechanism of placebo effects. This study also contributes to the IS literature on software pricing. In addition to the macro-level market analysis, future research should also investigate users' reaction to marketing information. Although I only investigate the effect of price in this study, it provides a point of departure for further behavior studies in how users react to marketing actions of software products.

However, several limitations of this study point to important research directions. The results are derived from a single study that involves a group of voluntary undergraduate students. Although this sample is reasonably representative of focal software product

users, I cannot rule out self-selection biases. The results need to be interpreted with caution. Future studies using different user-groups can help further validate the study results. A spreadsheet package is used as the target software in this study; it only represents a certain type of software package on the market. Other types of software products, such as web-interfaced service, mobile applications, and enterprise software, can be examined in further studies. In addition, only user satisfaction is investigated as the overall perceptual outcome of using the software product. However, other perceptions, such as perceived usefulness, and perceived quality, are also important to users' purchasing decisions. A broader set of outcomes can be further examined. Furthermore, the context of using the software product is ignored in this study. Nevertheless, users are not seeing a software product in a vacuum; contextual factors, such as social influence, facilitating conditions and job requirements, need to be also taken into consideration.

Appendix A: Decision Problems Used in the Study

1. What is the average of the following numbers?

2530
58
5992
23420
3849
2346
3245
9877
8750
27356
82375

2. What is the square root of 564,423?

3. What is the median of the following numbers?

320301
315471
400059
386968
262252
302363
503502
552581
319247
278048
209943
383014
342755
212728
366947

4. The Expected Monetary Value (EMV) is calculated by multiplying a outcome value by its probability.

EMV= Value-A * Probability-A + Value-B * Probability-B+...

Assume your manager believes there is a 22% chance of success for product A, and the expected net profit for product A is $1.78 million dollars; there is also an 18% chance of success for product B, and the expected net profit of product B is $2.65 million dollars. What is the EMV of the project of launching both product A and B?

5. Company X is going to buy elevator rails from a supplier, and has obtained samples of 10 elevator trails from the supplier. The diameters of the sample rails are listed in the following table. What is the standard deviation for the diameters of the sample rails?

    1.00
    0.98
    1.02
    1.01
    1.00
    0.99
    0.99
    1.00
    1.01
    1.00

6. Company Y is going to buy elevator rails from a supplier, and has obtained samples of 10 elevator trails from the supplier. The diameters of the sample rails are listed in the following table. What is the average diameter of the sample rails?

    1.00
    0.98
    1.02
    1.01
    1.00
    0.99
    0.99

1.00
1.01
1.00

7. The net present value (NPV) of an income stream is the sum of the present values of the individual amounts in the income stream. Each future income amount in the stream is discounted, meaning that it is divided by a number representing the opportunity cost of holding capital from now (year 0) until the year when income is received or the outgo is spent.

$$NPV = I_0 + \frac{I_1}{1+r} + \frac{I_2}{(1+r)^2} + \ldots + \frac{I_n}{(1+r)^n}$$

The *I* 's are income amounts for each year. The subscripts (which are also the exponents in the denominators) are the year numbers, starting with 0, which is this year. The discount rate – assumed to be constant in the future – is *r*. The number of years the investment lasts is *n*.

Assume your manager believes that a new product can bring in $2 million dollars in year 1, $1.5 million dollars in year 2, $1 million dollars in year 3, and $2.5 million dollars in year 4. If the discount rate is 0.0547, what is the NPV of the returns (in millions)?

Appendix B: Question Items Included in the Study

Expectancy (Shiv et al., 2005a)

EXP-1: By using As-Easy-As, I can get the correct answer to a decision problem.
EXP-2: By using As-Easy-As, I can reduce the amount of time it usually takes to solve a decision problem.
EXP-3: By using As-Easy-As, I can reduce the efforts it usually takes for me to solve a decision problem.
EXP-4: I expect As-Easy-As allows me to get the correct answer to a decision problem.
EXP-5: I expect As-Easy-As allows me to solve a decision problem more quickly.
EXP-6: I expect As-Easy-As allows me to solve a decision problem more easily.

Satisfaction (Au, Ngai, & Cheng, 2008)

SF-1: I am very contented with As-Easy-As.
SF-2: I am very pleased with As-Easy-As.
SF-3: I feel delighted with As-Easy-As.
SF-4: Overall, I am very satisfied with As-Easy-As.

Willingness to Pay

WTP-1: I would like to pay the following amount to purchase As-Easy-As:

$0~$20	$21~$40	$41~$60	$61~$80
$81~$100	$101~$120	$121~$140	$141~160
$161~$180	$181~$200	More than $200	

Computing Ability Scale (Kay, 1993).

CA-1: I feel confident learning a software package that I have never used before.
CA-2: I feel confident using computer-aided instruction to teach me how to use software.
CA-3: I feel confident teaching someone to use a computer software package.
CA-4: I could probably teach myself most of the things I need to know about computers.
CA-5: I can make the computer do what I want it to do.
CA-6: If I had a problem using the computer, I could solve it one way or another.

References

Adams, J.S. 1965. Inequity in social exchange. In L. Berkowitz (ed.), ***Advances in Experimental Social Psychology (Vol. 2)***. New York: Academic Press (pp. 267-299).

Ajzen, I., & Madden, T.J. 1986. Prediction of goal-directed behavior: Attitudes, intention and perceived behavioral control. ***Journal of Experimental Social Psychology***, 22(5): 453-474.

Almenberg, J., & Dreber, A. 2010. When does the price affect the taste? Results from a wine experiment. ***SSE/EFI Working Paper Series in Economics and Finance*** No. 717. Available at SSRN: http://ssrn.com/abstract=1392208

Atkinson, J.W. 1957. Motivational determinants of risk taking behavior. ***Psychological Review***, 64: 359-372

Au, N., Ngai, E.W.T., & Cheng, T.C.E. 2008. Extending the understanding of end user information systems satisfaction formation: An equitable needs fulfillment model Approach. ***MIS Quarterly***, 32(1): 43-66.

Bailey, J.E., & Pearson, S.E. 1983. Development of a tool for measuring and analyzing computer user satisfaction. ***Management Science***, 29(5): 530-545.

Bakos, Y., & Brynjolfsson, E. 1999. Bundling information goods: Pricing, profits, and efficiency. ***Management Science***, 45(12): 1613-1630.

Bhargava, H.K., & Choudhary, V. 2001. Information goods and vertical differentiation. ***Journal of Management Information Systems***, 18(2): 89-106.

Bolton, R.N., & Lemon, K.N. 1999. A dynamic model of customer's usage of services: Usage as an antecedent and consequence of satisfaction. ***Journal of Marketing Research***, 36(2): 171-186.

Brynjolfsson, E., & Kemerer, C.F. 1996. Externalities in microcomputer software: An econometric analysis of the spreadsheet market. ***Management Science***, 42(12): 1627-1647.

Business Software Alliance. 2009. Software industry facts and figures. http://www.bsa.org/country/Public/520Policy/~/media/Files/Policy/Security/General/sw_factsfigures.ashx. (Accessed at March 20, 2010).

Chau, P.Y.K., & Hu, P.J. 2002. Examining a model of information technology acceptance by individual professionals: An exploratory study. ***Journal of Management Information Systems***, 18(4): 191-229.

Chellappa, R.K., & Shivendu, S. 2005. Managing piracy: Pricing and sampling strategies for digital experience goods in vertically segmented markets. ***Information Systems Research***, 16(4): 400-417.

Chen, Y., & Png, I. 2003. Information goods pricing and copyright enforcement: Welfare analysis. ***Information Systems Research***, 14(1): 107-123.

Chin, W.W. 2010. How to write up and report PLS analyses. In V. E. Vinzi et al (eds.), ***Handbook of Partial Least Squares: Concepts, Methods and Applications***. Berlin: Spinger (pp. 655-690).

Clements, P., & Northrop, L. 2001. ***Software Product Lines: Practices and Patterns***. Reading, MA: Addison-Wesley.

Davis, F.D. 1989. Perceived usefulness, perceived ease of use, and user acceptance of information technology. ***MIS Quarterly***, 13(3): 319-339.

Davis, F.D., Bagozzi, R.P., & Warshaw, P.R. 1989. User acceptance of computer technology: A comparison of two theoretical models. ***Management Science***, 35(8): 982-1003.

DeLone, W.H., & McLean, E.R. 1992. Information systems success: The quest for the dependent variable. ***Information Systems Research***, 3(1): 60-95.

Doll, W.J., & Torkzadeh, G. 1988. The measurement of end-user computing satisfaction. ***MIS Quarterly***, 12(2): 259-274.

Duan, W., Gu, B., & Whinston, A.B. 2009. Informational cascades and software adoption on the internet: An empirical investigation. ***MIS Quarterly***, 33(1): 23-48.

Eccles J.S., Adler, T.F., Futterman, R., Goff, S.B., Kaczala, C.M., Meece, J.L., & Midgley, C. 1983. Expectancies, values, and academic behaviors. In J.T. Spence (ed.), ***Achievement and Achievement Motivation***. San Francisco, CA: W. H. Freeman (pp. 75-146).

Gallaugher, J.M., & Wang, Y.-M. 2002. Understanding network effects in software markets: Evidence from web server pricing. ***MIS Quarterly***, 26(4): 303-327.

Geers, A.L., Weiland, P.E., Helfer, S.G., Kosbab, K., & Landry, S.J. 2005. Goal activation, expectations, and the placebo effect. ***Journal of Personality and Social Psychology***, 89(2): 143-159.

Gerstner, E. 1985. Do higher prices signal higher quality? ***Journal of Marketing Research***, 22(2): 209-215.

Gopal, R.D., & Sanders, G.L. 2000. Global software piracy: You can't get blood out of a turnip. ***Communications of the ACM***, 43(9): 83-89.

Grewal, D., Monroe, K.B., & Krishnan, R. 1998. The effects of price-comparison advertising on buyers' perceptions of acquisition value, transaction value, and behavioral intentions. ***Journal of Marketing***, 62(2): 46-59.

Haruvy, E., & Prasad, A. 2001. Optimal freeware quality in the presence of network externalities: an evolutionary game theoretical approach. ***Journal of Evolutionary Economics***, 11(2): 231-248.

Homburg, C., Koschate, N., & Hoyer, W.D. 2005. Do satisfied customers really pay more? A study of the relationship between customer satisfaction and willingness to pay. ***Journal of Marketing***, 69(2): 84-96.

Hsu, J.L., & Shiue, C.W. 2008. Consumers' willingness to pay for non-pirated software. ***Journal of Business Ethics***, 81(4): 715-732.

Hyland, M.E., & Whalley, B. 2008. Motivational concordance: An important mechanism in self-help therapeutic rituals involving inert (placebo) substances***. Journal of Psychosomatic Research***, 65(5): 405-413.

Irmak, C., Block, L.G., & Fitzsimons, G.J. 2005. The placebo effect in marketing: Sometimes you just have to want it to work. ***Journal of Marketing Research***, 42(4): 406-409.

Jensen, M.P., & Karoly, P. 1991. Motivation and expectancy factors in symptom perception: A laboratory study of the placebo effect. ***Psychosomatic Medicine***, 53(2): 144-152.

Jorgensen, M., & Shepperd, M. 2007. A systematic review of software development cost estimation studies. ***IEEE Transactions on Software Engineering***, 33(1): 33-53.

Kay, R.H. 1993. A practical research tool for assessing ability to use computers: The computer ability survey (CAS). ***Journal of Research on Computing in Education***, 26(1): 16-27.

Khouja, M., & Park, S. 2007. Optimal pricing of digital experience goods under piracy. ***Journal of Management Information Systems***, 24(3): 109-141.

Kirsch, I. 1985. Response expectancy as a determinant of experience and behavior. ***American Psychologist***, 40, 1189-1202.

Kirsch, I. 1997. Response expectancy theory and application: A decennial review. ***Applied and Preventive Psychology***, 6, 69-79.

Krishnan, M.S., Kriebel, C.H., Kekre, S., & Mukhopadhyay, T. 2000. An empirical analysis of productivity and quality in software products. ***Management Science***, 46(6): 745-759.

Lanotte, M., Lopiano, L., Torre, E., Bergamasco, B., Colloca, L., & Benedetti, F. 2005. Expectation enhances autonomic responses to stimulation of the human subthalamic limbic region. ***Brain, Behavior, and Immunity***, 19(6): 500-509.

Li, X., & Hitt, L.M. 2010. Price effects in online product reviews: An analytical model and empirical analysis. ***MIS Quarterly***, 34(4): 809-831.

Lucas, Jr., H.C., Walton, E.J., & Ginzberg, M.J. 1998. Implementing packaged software. ***MIS Quarterly***, 12(4): 537-549.

McKinney, V., Yoon, K., & Zahedi, F.M. 2002. The measurement of Web-customer satisfaction: An expectation and disconfirmation approach. ***Information Systems Research***, 13(3): 296-315.

Muylle, S., Moenaert, R., & Despontin, M. 2004. The conceptualization and empirical validation of website user satisfaction. ***Information & Management***, 41(5): 543-560.

Nagle, T.T., & Holden, R.K. 2002. ***The Strategy and Tactics of Pricing*** (Third Edition). Upper Saddle River, NJ: Prentice-Hall Inc.

Nunnally, J. 1978. ***Psychometric Theory***. New York: McGraw-Hill.

O'Boyle, D.J., Binns, A.S., & Sumner, J.J. 1994. On the efficacy of alcohol placebos in inducing feelings of intoxication. ***Psychopharmacology***, 115(1-2): 229-236.

Oliver, R. 1974. Expectancy theory predictions of salesmen's performance. ***Journal of Marketing Research***, 11, 243-253.

Plassmann, H., O'Doherty, J., Shiv, B., & Rangel, A. 2008. Marketing actions can modulate neural representations of experienced pleasantness. ***Proceedings of the National Academy of Sciences of the United States of America (PNAS)***, 105(3): 1050-1054.

Price, D.D., & Fields, H.L. 1997. The contribution of desire and expectation to placebo analgesia: Implications for new research strategies. In A. Harrington (ed.), ***The Placebo Effect: An Interdisciplinary Exploration***. Cambridge, MA: Harvard University Press (pp. 93-116).

Rao, A.R. 2005. The quality of price as a quality cue. ***Journal of Marketing Research***, 42(4): 401-405.

Rautio, T., Anttila, M., & Tuominen, M. 2007. Bundling of information goods: A value driver for new mobile TV services. ***International Journal of Revenue Management***, 1(1): 45-64.

Shapiro, A.K., & Shapiro, E. 1984. Patient-provider relationships and the placebo effect. In Matarazzo, J.D., Weiss, S.M., Heird, J.A., Miller, N.E., & Weiss, S.M. (eds):

Behavioral Health: A Handbook of Health Enhancement and Disease Prevention. New York: Wiley (pp. 371-383).

Shiv, B., Carmon, Z., & Ariely, D. 2005a. Placebo effects of marketing actions: Consumers may get what they pay for. ***Journal of Marketing Research***, 42(4): 383-393.

Shiv, B., Carmon, Z., & Ariely, D. 2005b. Ruminating about placebo effects of marketing actions. ***Journal of Marketing Research***, 42(4): 410-414.

Smith, G. E., & Nagle, T.T. 2002. How much are your customers willing to pay? ***Marketing Research***, 14(4): 20-25.

Stewart-Williams, S., & Podd, J. 2004. The placebo effect: Dissolving the expectancy versus conditioning debate. ***Psychological Bulletin***, 130 (2): 324-340.

Sundararajan, A. 2004a. Nonlinear pricing of information goods. ***Management Science***, 50(12): 1660-1673.

Sundararajan, A. 2004b. Managing digital piracy: Pricing and protection. ***Information Systems Research***, 15(3): 287-308.

Takeyama, L.N. 2009. Copyright enforcement and product quality signaling in markets for computer software. ***Information Economics and Policy***, 21(4): 291-296.

Tam, K.Y. 1996. Dynamic price elasticity and the diffusion of mainframe computing. ***Journal of Management Information Systems***, 13(2): 163-183.

Tiwana, A., & Ramesh, B. 2001. A design knowledge management system to support collaborative information product evolution. ***Decision Support Systems***, 31(2): 241-262.

Vallerand, R.J. 1997. Toward a hierarchical model of intrinsic and extrinsic motivation. ***Advances in Experimental Social Psychology***, 29: 271-360.

Venkatesh, V. 2000. Determinants of perceived ease of use: Integrating control, intrinsic motivation, and emotion into the Technology Acceptance Model. ***Information Systems Research***, 11(4): 342-365.

Venkatesh, V., Morris, M.G., Davis, G.B., & Davis, F.D. 2003. User acceptance of information technology: Toward a unified view. ***MIS Quarterly***, 27(3): 425-478.

Wigfield, A., & Eccles, J.S. 2000. Expectancy–value theory of achievement motivation. ***Contemporary Educational Psychology***, 25(1): 68-81.

CHAPTER 3

INCORPORATING USER PERCEPTIONS AND PRODUCT ATTRIBUTES IN SOFTWARE PRODUCT DESIGN AND EVALUATION

Introduction

The processes that consumers use to make choices among product alternatives have been of interest to researchers and managers alike. For example, individual consumers often make choices among software products with varying relative strengths and limitations on the basis of key attributes, such as price, functionality, and vendor support. To improve product differentiation and meet consumers' needs better, software vendors must understand the key drivers that affect consumers' choices of alternative software products. Specifically, packaged software products are designed with fixed sets of functionalities to solve problems shared by common users (Lucas, Walton, & Ginzberg, 1988); the main objective of packaged software design is to determine the optimal combination of product features for sale to a market (Carmel & Sawyer, 1998). Different methods have been applied to guide product design decisions; such methods typically attempt to measure the importance that consumers place on various product attributes and use those measurements to make design trade-offs (Feit, Beltramo, & Feinberg, 2010).

In studies of users' choices of packaged software, mobile applications (apps) represent a new research opportunity. With the pervasive use of mobile devices, software applications running on these mobile devices have become increasingly common (Adipat, Zhang, & Zhou, 2011) and define a new category of packaged software. The unique constraints of handheld devices (e.g., small screen size and limited memory) pose new challenges to the design of mobile apps (Adipat et al., 2011). However, relatively little knowledge has been accumulated in designing mobile user experiences, while a wide range of mobile apps are launched and continue to grow.

In order to better explain users' selection behavior in mobile app purchases, this study investigates the influences of both product attributes and user perceptions on software product selection. Product attributes can be directly observed; they represent the "facts" about a product that are available to consumers. The vendor can configure these attributes to define the product profile; the existing literature on product design has focused on alternating attributes to find optimal product profiles. User perceptions instead represent individual opinions; prior research has suggested that a user's outcome behavior reflects how he/she perceives the key attributes of a technology (Moore & Benbasat, 1991). Product attributes and user perceptions may be equally critical in consumers' choices, and both need to be included in studies of users' choices of packaged software (Ashok, Dillon, & Yuan, 2002; Luo, Kannan, & Ratchford, 2008).

This study focuses on the general factors affecting users' purchasing decisions, and incorporates the technique of conjoint analysis (Green & Rao, 1971; Green & Srinivasan, 1990) to model users' preferential choices and the possible tradeoffs among various product attributes and perceived characteristics. Specifically, this study addresses the

following question: Is it possible to explain consumers' packaged software preferences better using choice-based conjoint analyses that include both product attributes and consumer-perceived characteristics, rather than one or the other?

By examining the factors affecting users' evaluations of software before actual purchase, this study contributes to the literature by providing a better understanding of how product attributes, price, size of user base, vendor support level, and users' perceived characteristics jointly determine consumers' software-choice decisions. In addition, by investigating the causal relationships between product attributes and perceived characteristics, I provide valuable insights regarding the underlying process of how consumers manage the information of product attributes and then make decisions. I also develop a generalizable approach to incorporate user perceptions into an optimal new product design process. For practitioners, the model estimation results can help vendors make informed decisions on designing mobile apps. Including product price in the model estimation together with other attributes can also provide insights on how users trade-off product features with price (Wittink & Cattin, 1989), and thus facilitate vendors' pricing and packaging/versioning strategies.

Literature Review

This study relates to several streams of research, including consumers' selections of software products, and mobile application design, that I provide overviews to in this section. I also review prior research which investigates technology and product adoption, as well as the conjoint analysis in particular, to highlight motivation.

Software Product Selection

In the literature, most research in software selection has been done in organizational settings (e.g., Chau, 1995; Howcroft & Light, 2006; Lai, Trueblood, & Wong, 1999; Lai, Wong, & Cheung, 2002; Liberatore & Pollack-Johnson, 2003). Strategic factors, technical factors and organizational context are used in this stream of research to explain packaged software selection. Nevertheless, software selection in organizations can be a group decision by owners and managers (Chau, 1995), which represents a major difference from individual users' software selection. Individual users consider factors that vary a lot from organizations; individuals' software selection is therefore, another critical area that deserves in-depth investigation and empirical examination.

Some critical factors influencing users' software assessment have been identified, including product functions, price, vendor support, and user base. An individual user selects a software product mainly based on the functionalities valuable to him/her for achieving particular goals, or the product's usability (Bevan, 1995; Nielsen, 1993). Prior research has pointed out that product functions are critical in users' software assessment (Calisir & Calisir, 2004), and play an important role in users' software selection decision. Price is another critical factor in consumers' purchasing decisions. It not only affects users' value evaluation, but also is used as a reference for unobserved quality (Gerstner, 1985). It is assumed that consumers can rationally infer quality from price, and sellers can use price as a marketing mechanism to communicate the product's unobservable quality (Shiv, Carmon, & Ariely, 2005). Previous research has examined the effects of price on consumers' valuations for a software product (Bakos & Brynjolfsson, 1999), consumers' piracy intention (Cheng, Sims, & Teegen, 1997), and product diffusion (Tam,

1996). For computer software, the product price reflects only a relatively small portion of the total consumer expenditure; consumers need to pay learning and conversion costs for using new computer software (Brynjolfsson & Kemerer, 1996; Cheng & Tang, 2010) as well.

Prior research in users' software selection has identified some external control factors that play an important role in shaping users' choices. They are factors external to the product designs, but the vendors somehow have direct or indirect control over these factors (Quaddus & Hofmeyer, 2007). For example, vendor support and user base are identified as critical external control factors affecting users' preferences (Quaddus & Hofmeyer, 2007). Vendor support refers to the level of technical support offered by a vendor for implementing and using a technology-based solution (Quaddus & Hofmeyer, 2007). The access to external support can lower knowledge barriers and reduce the learning cost of using a new software product (Chau, 1995). Vendor support is essential in reducing learning and conversion costs, and therefore, is important in selecting packaged software (Anderson, 1990; Chau, 1995; Lai et al., 1999; Lai et al., 2002). In addition, the size of user base matters in the presence of a positive network externality (Cheng, 2011). Network externalities refer to the increase of consumer utility when more people become the users of the same product or service (Cheng, 2011; Farrell & Saloner, 1985; Katz & Shapiro, 1985; Gallaugher & Wang, 2002). Consumers prefer software that has a large user base and is perceived as a standard or is compatible with other products (Farrell & Saloner, 1985). The success of a software product may depend in part on the user base, or the installed base, because of network externalities (Brynjolfsson & Kemerer, 1996; Gallaugher & Wang, 2002).

Mobile Application Design

The new market of mobile apps has been developed by independent software vendors using the respective proprietary development kit and APIs, these applications are available online and can be downloaded directly onto the respective smartphone (Pitt, Parent, Junglas, Chan, & Spyropoulou, 2011). The constant development of mobile apps has drawn the attention of the research community who seek to identify market and technology trends for mobile apps (Holzer & Ondrus, 2011). For example, Holzer and Ondrus (2011) suggest that the variety of mobile devices increases freedom for developers but increases the development costs for customization. It is therefore, even more important for mobile app developers to carefully design functionalities before starting the actual product development. In addition, users evaluate the overall usability based on functional design, and therefore, the functionality to be obtained by users for executing a specific task is evidently crucial in mobile app development (Biel, Grill, & Gruhn, 2010). Thus, identifying the optimal design of mobile apps appears to be critical for vendors to reduce development costs, yet achieve success in the mobile app marketplace.

Various guidelines for interface design of mobile apps are also proposed (e.g., Eliasson, Pargman, Nouri, Spikol, & Ramberg, 2011; Lee & Benbasat, 2004), mainly focusing on the unique characteristics of mobile devices, such as screen size, and information presentation that are fundamentally different from personal computers (Adipat et al., 2011). There are significant differences between mobile apps and computer-enabled applications (Pitt et al., 2011), and therefore, it suggests the need to re-examine software product design issues for mobile apps (Adipat et al., 2011; Pitt et al.,

2011). Additionally, some studies have explored the process of mobile app acceptance from the perspective of new technology adoption (Faullant, Fuller, & Matzler, 2012; Lee & Benbasat, 2004). Among the determinants of users' mobile app acceptance, contextual factors have been recognized as critical (Alarcon, 2006; Biel et al., 2010; Charland & Leroux, 2011; Faullant et al., 2012), for mobile apps are often adopted in highly social contexts (Faullant et al., 2012) and therefore can affect users' adoption decisions.

Technology and Product Adoption

Several profound models rooted in psychological theories have been developed for explaining individual users' adoption of technology and new products, including the theory of reasoned action (TRA, Ajzen & Fishbein, 1980), innovation diffusion theory (IDT, Roger, 1983) and the technology acceptance model (TAM, Davis, 1989). The TAM was developed specifically for explaining and predicting user technology adoption behavior (Venkatesh, 2000; Chau & Hu, 2001). The TAM has roots in several diverse theoretical perspectives, including IDT that identifies perceived characteristics of technology that may be expected to influence user adoption of that technology, as well as the TRA that explains how user beliefs and attitudes are related to individual intentions to perform. Overall, this stream of research emphasizes that a user's behavior reflects how he/she perceives the key attributes of a technology or a new product (Moore & Benbasat, 1991). Specifically, individuals' perceptions predict attitudes toward adoption, and explain individual users' behavioral intentions and their behaviors (Chau & Hu, 2001; Davis, 1989; Davis, Bagozzi, & Warshaw, 1989; Taylor & Todd, 1995; Venkatesh, 2000).

The TAM has been empirically tested in a wide array of user acceptance scenarios, including e-mail (e.g., Gefen & Straub, 1997), telemedicine (Hu, Chau, Sheng, & Tam, 1999), office automation software (e.g., Mathieson, 1991), online purchases (e.g., Koufaris, 2002), enterprise information systems (Venkatesh, Morris, Davis, & Davis, 2003), innovative user interfaces (Agarwal & Prasad, 1999), and e-learning (Cheng, 2011). On average, this parsimonious model can explain 35–70% of the variance in intentions. Among its suggested determinants, attitude seems to be the most important predictor of intention. In turn, perceived usefulness and perceived ease of use determine attitude.

In this stream of research, product attributes such as brand, price, and functionality are generally avoided, and their influences on users' adoption are assumed to be mediated by users' perceptions. User perceptions can be perceived product characteristics (e.g., perceived ease of use and perceived usefulness; Davis, 1989; Davis et al., 1989), or perceived contextual factors (e.g., social influence and facilitating conditions; Venkatesh et al., 2003). Studies in consumers' adoption behavior of new products also investigate the influences of external factors, such as social network and community (Iyengar, Van den Bulte, & Valente, 2011), brand (Thompson & Sinha, 2008), product quality (Nam, Manchanda, & Chintagunta, 2010), and consumers' personal traits (Im, Bayus, & Mason, 2003). Various theoretical perspectives are used to explain users' adoption behavior, such as imitation and herding in explaining others' influence (Huang & Chen, 2006), social contagion and contiguous word of mouth in social networks (Iyengar et al., 2011; Nam et al., 2010), brand loyalty (Thompson & Sinha, 2008), and innate consumer innovativeness

(Im et al., 2003). While numerous factors can affect users' product adoption behavior, it is not easy to make conclusions on the joint effects of these determinants.

In sum, this stream of research examines consumers' adoption behavior regarding a new technology or product. It focuses on describing the consumer's perception of one specific product and the factors affecting consumers' adoption decisions of the given product in a generic sense. Other products introduced in the market at the same time were not taken into consideration. Thus, this research approach is rarely applied to studies of how users choose from different software products.

Conjoint Analysis

In evaluating various factors influencing users' product selection, conjoint analysis has been an important technique to help understand users' choices. It was developed in mathematical psychology with solid theoretical basis (Anderson, 1977; Luce & Tukey, 1964), and has been widely employed to model buyer's selections among multi-attributed products or services for over 40 years (Green & Rao, 1971; Green & Srinivasan, 1990; Meyer & Sathi, 1985; Wittink & Cattin, 1989). Conjoint analysis is based on the premise that any product or service can be described by its attributes and that the extent to which an individual values a product or service depends on the levels of these attributes. For products composed of multiple attributes, conjoint analysis can be used to determine which attributes are important to preferences and what combinations of attribute levels are most preferred (Green, Krieger, & Wind, 2001).

The problem a consumer faces in making purchasing decisions is often how to trade off the possibility that option X is better than option Y on attribute A, while Y is better

than X on attribute B, and various extensions of these conflicts (Green et al., 2001). Conjoint analysis is used for handling such situations in which a decision maker has to deal with options that simultaneously vary across multiple attributes. Rather than directly ask survey respondents what they prefer in a product, or what attributes they find most important, conjoint analysis employs the more realistic context of respondents evaluating potential product profiles. Such techniques require the participants to analyze a variety of decision-making scenarios in which the independent variables are experimentally manipulated. It can be used to show how people are willing to trade between characteristics, to rank alternative products or services while priority of attributes are assigned, to estimate the individual impact of each attribute on consumers' preferences, to simulate how consumers might react to changes in the array of candidate products, and to illustrate the relative importance of different attributes of a product or service (Cattin & Wittink, 1982; Green & Srinivasan, 1990; Green et al., 2001; Wittink & Cattin, 1989). The strength of the conjoint approach is that it combines the control of a laboratory experiment with the external validity of a survey (Tiwana & Bush, 2007).

For conjoint studies, either a rating-based design, or a choice-based design can be employed. In a rating-based conjoint study, respondents rate their preferences for different product profiles, and then attribute partworths are estimated with ordinary least square (OLS) regression. On the other hand, in a choice-based conjoint study, respondents make choices from sets of product profiles and the parameters are estimates with logit or probit models (Karniouchina, Moore, van der Rhe, & Verma, 2009; Louviere & Woodworth, 1983). Although rating-based studies are easier to design and estimate (Karniouchina et al., 2009), researchers have identified several benefits of using choice-

based design over rating-based design: (1) The similarity between choices and actual market behavior leads to greater external validity (Elrod, Louviere, & Davey, 1992; Louviere & Woodworth, 1983). (2) Choice-based studies provide choice probabilities directly while rating-based studies use ad hoc rules (e.g., maximum utility or share of preference) to convert preference ratings into choice probabilities (Karniouchina et al., 2009; Louviere & Woodworth, 1983). (3) The probable prominence effect (which is the tendency to give more weight to the more important attributes) is found to be greater for rating-based models than choice-based models (Moore, 2004; Tversky, Sattath, & Slovic, 1988).

The great complexity typical of software products implies the need to manage a large number of attributes simultaneously. Hence, it is appropriate to use conjoint analysis techniques, which are particularly well suited to handling a large number of factors (Marzocchi, Brasini, & Rimessi, 2003), in software design studies involving user evaluations. Nevertheless, conjoint analysis has not yet been widely applied in the software product design area.

Gap Analysis and Motivation

Prior studies in technology and new product adoption mainly focus on factors influencing individuals' perceptions and attitudes. The assumption is that user perceptions mediate the impact of external stimuli on users' behavioral intentions and adoption behaviors. Nevertheless, the probable direct effects of product attributes on users' selection decisions have been overlooked, and the assumed mediating role of user perceptions needs further validation with empirical supports. For example, some product

attributes, such as price, can influence users' choice directly. The direct influences of product attributes should be further investigated.

Prior research in technology and product adoption may also fall short in identifying the influences of product attributes on consumer-perceived characteristics. While prior research results based on user perceptions provide valuable insights on how users' adoption decisions are made, how various product designs can affect user perceptions remains unclear. On the other hand, the existing literature on product design has mostly focused on user requirement analysis and alternating product attributes to find optimal product profiles. Only product attributes are applied in commercial use to estimate the impact of selected product attributes on customer preferences for products (Cattin & Wittink, 1982). However, consumer preference for a product is only partially captured by the direct effects of product attributes (Srinivasan, Lovejoy, & Beach, 1997; Tybout & Hauser, 1981). In both research streams, the influences of product attributes on user perceptions are mostly discounted. In order to more precisely model consumers' product preference, there is a need to incorporate user perceived characteristics in product design (Luo et al., 2008).

The effects of price on consumers' product evaluations and purchasing behaviors are also essential and still deserve continuous research attention. Prior studies concerning software product price have not yet incorporated other product attributes to model the relative importance of product price in users' evaluation. Additionally, vendor support and network externality are shown to be critical for packaged software adoption as well (Duan, Gu, & Whinston, 2009; Lucas et al., 1988; Tellis, Yin, & Hiraj, 2009). Although software product vendors can use various strategies to manipulate those contextual

factors, vendor support and network externality have not yet been included in product design evaluation, together with other product attributes and price, to further investigate their effects.

In order to address these research gaps, this study proposes a model incorporating product attributes and user perceived characteristics to estimate their joint effects on users' choices. The influences of product attributes on user perceived characteristics are also estimated in order to more precisely capture the process of users' selection decision. I also compare the proposed model with two alternative models: (1) only latent constructs of user perceptions are used as explanatory variables, and (2) only product attributes are used to predict the consumers' choices. By comparing the testing results of the models, I provide insights regarding a relatively effective way to model users' preferential choices.

A prior study by Luo et al., (2008) has incorporated the user perceived product characteristics into a rating-based conjoint study. They include perceptual measures in rating-based conjoint studies, and show that the in-sample fit and predictive power are improved. Specifically, the in-sample fit examined by root mean square discrepancy (RMSD) is improved by 0.02 – 0.17; the predictive power represented by mean absolute error (MAE) is increased by 0.016 – 0.057. However, this approach has not yet been empirically validated using a choice-based design. There is a need to incorporate user perceptions in the choice-based conjoint studies for several reasons. First, considering the different estimation methods, a newly proposed conceptual model needs to be operationalized and validated using both rating-based and choice-based study designs (Luo et al., 2008). Second, choice-based conjoint study has become the most popular type of conjoint study (Halme, & Kallio, 2011), given the benefits of the choice-based design,

and the availability of software tools that facilitate the choice-based conjoint study design (e.g., Sawtooth Software). By incorporating user perceptions in choice-based conjoint studies, I can empirically develop methods to estimate the effects of product attributes on user perceptions in choice-based studies, and suggest a generalizable approach to incorporate user perceptions for choice-based conjoint studies.

In addition, the purpose of Luo et al.'s (2008) study is to demonstrate the importance of incorporating perceptual measures in conjoint analysis, and therefore they did not emphasize on why these perceptual measures are included in the study. The perceptual measures included in their study (i.e., perceived power, perceived comfort, and perceived effectiveness) are specific to the products used (i.e., a power tool and a toothbrush) and therefore may not be applicable to other product categories. On the other hand, TAM and other extended models have provided a solid theoretical foundation recognizing important perceptual factors in users' software product evaluation. Incorporating perceptual factors based on TAM and the extended models in conjoint analysis can provide a more comprehensive and generalizable foundation for future research in software product selection.

Theoretical Foundation and Framework

In order to address the research questions, I develop a framework built upon individuals' information processing strategies (Jacoby, 1976; Kassarjian, 1982) and the personal construct theory (Kelly, 1970). As shown in Figure 3.1, the framework depicts the process associated with individual users' formation of software preference.

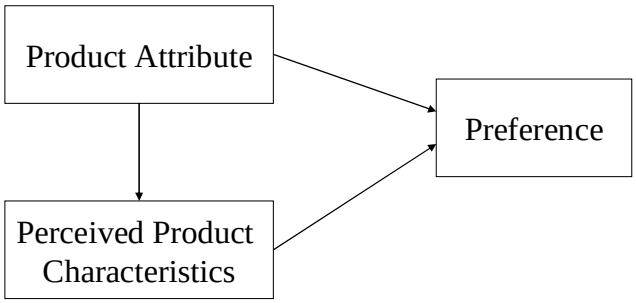

Figure 3.1. Research Framework of the Software Choice Study

According to the multi-attribute approach in choice research (Jacoby, 1976; Kassarjian, 1982), a consumer's preference is either developed via attribute-based or attitude-based information processing. Consumers use the two information-processing strategies to judge products and make purchasing decisions. In attribute-based processing, all relevant information is directly observable in the judgment context, and consumers can readily and directly compare all products on all attributes (Mantel & Kardes, 1999). The multi-attribute utility theory (Fishburn, 1970; Keeney & Raiffa, 1976) provides a theoretical foundation to evaluate the desirability of multi-attribute consequences. According to the multi-attribute utility theory, a rational decision maker's overall evaluation of a product is determined by a multi-attribute utility function, which is expressed as a weighted summation of the attribute utility functions of each attribute taken singly. The decision maker gives weights to different attributes with respect to their relevant value. The multi-attribute utility theory enables the decision maker to structure a complex problem in the form of a simple hierarchy. Consumers focus on relevant information and the decision process is data driven and analytic in attribute-based processing (Alba & Hutchinson, 1987). The attribute-based strategy involves the use of

attribute-by-attribute comparisons across products. The exact manner in which relevant attribute knowledge is accessed, weighed, or compared may vary considerably (Sanbonmatsu & Fazio, 1990). The attribute-based process is therefore, time consuming, effortful, and usually accurate (Mantel & Kardes, 1999).

On the other hand, consumers may also use an attitude-based strategy to make judgments. Attitude-based information processing involves the use of perceptions, general attitudes, past experiences, impressions or heuristics, all of which are highly related with personal idiosyncrasy (Mantel & Kardes, 1999). Individuals with different idiosyncrasies would perceive the same information or stimuli differently, and form their own perceptions regarding the presented facts (Luo et al., 2008). At the time a preference judgment is made in attitude-based processing, the decision maker relies on his/her perceptions to form a global attitude, and then uses these attitudes to assess alternatives. The decision is arrived at by selecting the alternative or option that has been given the most favorable overall assessment (Sanbonmatsu & Fazio, 1990). An attitude-based decision process is less deliberate, effortful, and time consuming than most attribute-based strategies (Mantel & Kardes, 1999). Attitude based decisions are in line with the TRA, that suggests individuals' perceptions are stimulated by external information (e.g., product attributes), that perceptions lead to attitude, and the attitude determines behavioral intention and selection behavior (Ajzen & Fishbein, 1980).

Attribute-based and attitude-based strategies represent the two major approaches of information processing in consumers' purchase decision making. Motivation and opportunity to process information work together to determine whether attribute-based or attitude-based processing would be used in a given situation (Sanbonmatsu & Fazio,

1990). Specifically, as motivation to make a correct judgment increases and specific attributes are accessible, individuals tend to use analytic, data-driven, attribute-based information processing (Mantel & Kardes, 1999). When users' product selection decisions are studied, the researchers do not exactly understand which information processing strategy is used.

Nevertheless, attribute-based information processing is often associated with attitude-based information processing. According to personal construct theory (Kelly, 1970), individuals develop internal models of reality in order to understand and explain the world around them; they develop these "constructs" based on observation. In the context of this study, users form their perceptions and attitudes based on the product attributes they observe. It is proposed that alternatives are compared directly on each attribute and individuals somehow combine all dimensional values (attributes) cognitively and come to an overall evaluation (attitude) before making decisions (Tversky, 1969). In other words, it is asserted that attribute-based information processing influences attitude-based information processing. Attributes may be used as external cues to form perceptions and general attitudes before a preference judgment is made (Mantel & Kardes, 1999). For example, brand names, prices and other product information often serve as external, heuristic cues that lead to consumers' positive or negative attitudes. The design of product appearances (e.g., color and shape) often affect users' perceptions. These perceptions and attitudes then affect consumers' product selection decisions (Maheswaran, Mackie, & Chaiken, 1992).

In the context of this study, when attributes of a software product are presented to consumers, consumers may compare these attributes directly to form their preferences.

For example, a consumer will increase or reduce his/her preference for a product merely because of the presence or non-presence of a specific functionality due to his/her needs. A consumer will also form his/her perceptions and attitude toward a product based on his/her prior experiences, beliefs, or contextual factors, as well as the product attributes presented. The consumer will use attributed-based information processing, attitude-based information processing, or both, to make product selection decisions.

Research Model

I derive a research model based on the conceptual framework and identify factors in different dimensions affecting individuals' software product selection. In addition to the product attributes and users' perceived product characteristics, I also include external control factors and contextual factors. Specifically, I capture users' perceptions as the proxy for their attitude toward the software. These factors can be categorized as product attributes (i.e., functionality and price), external control factors (i.e., vendor support and user base) and perceived product characteristics (i.e., effort expectancy and performance expectancy), and contextual factors (i.e., social influence and facilitation conditions), as depicted in Figure 3.2.

In this study, software preferential choice is defined as a relative tendency to purchase a specific product with a specific combination of attributes, compared to other products with distinct combinations of attributes (Park, Hughes, Thukral, & Friedmann, 1981), and represents the behavioral intention of users to use a specific product given the combination of attributes. In this study of choice-based conjoint analysis, an individual's

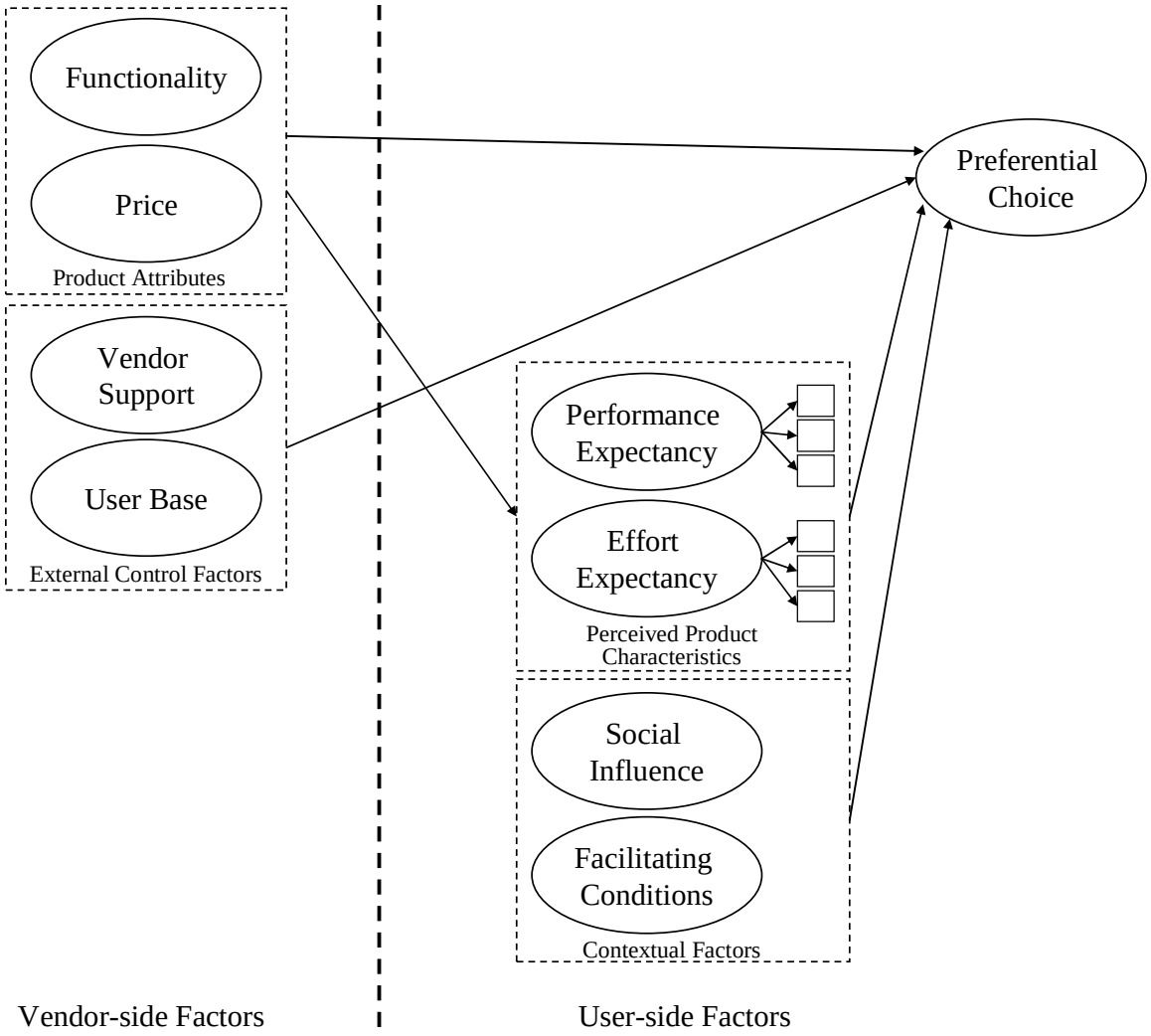

Figure 3.2. Research Model of the Software Choice Study

preferential choice is the probability with which he/she chooses one particular alternative from a choice set.

An individual's preferential choice is determined by the combination of product attributes, external control factors, perceived product characteristics by the user, and contextual factors. Product attributes are features that can be controlled and manipulated by vendors, including a set of functionalities and price. The presence or absence of a

certain product function will affect users' value evaluation of the software product, based on ones' needs. Price will determine users' selection decision by influencing their judgment of whether it will be a fair transaction (Homburg, Koschate, & Hoyer, 2005). Consumers incur various types of costs when using a software product (Cheng & Tang, 2010). External factors include the level of vendor support, and user base. A high level of vendor support can reduce users' time and effort spent to become familiarized with a software product. Although it is not a feature inherent to the software (i.e., the computer program), it is viewed as a part of the product package, and is taken into consideration in users' product assessment (Kekre, Krishnan, & Srinivasan, 1995). The size of user base represents the effect of network externality. Users are suspected to prefer products with a greater installed base for several reasons: (1) The number of network users is assumed to reflect long-term market stability (Katz & Shapiro, 1992). (2) Products with large user bases foster exchange of content or programs, and users obtain and add value through exchange with other users. (3) Dominant products are more likely to attract extrinsic benefits such as supportive content, books, manuals, and add-on products (Gallaugher & Wang, 2002).

Perceptions are users' assessments of the product and the context. Drawn from the literature in technology adoption (e.g., Davis, 1989; Venkatesh et al., 2003), I include performance expectancy and effort expectancy as the two fundamental perceived product characteristics that serve as mediators between product attributes and users' preferential choices. Performance expectancy, or perceived usefulness, is the degree to which a person believes that using a specific technology would enhance performance (Davis, 1989; Venkatesh et al., 2003). Effort expectancy, or perceived ease of use, is the extent to

which a person believes that using a technology would be free of effort (Davis, 1989; Venkatesh et al., 2003). The inclusion of performance expectancy and effort expectancy in studies of technology adoption is consistent with the research in behavioral decision making in which individuals attempt to minimize effort and adopt what is beneficial for them (Venkatesh, 2000). The two constructs have also been tested and generalized across different contexts, and the results of these studies have converged conclusions on the effects of performance expectancy and effort expectancy on adoption behavior.

Contextual factors are users' perceptions of the context, such as perceived facilitating conditions (Taylor & Todd, 1995) and social influence (Ajzen, 1991). Facilitating conditions are people's perceived constraints in shaping behavioral intention and behavior (Ajzen, 1991). The objective of providing better facilitating conditions is to supply necessary resources to reduce barriers users may encounter during the adoption of a new product or a technology. Social influence captures users' perception of normative pressure; it is implied that individuals' behavior is influenced by the way in which they believe others will view them as a result of having used the technology. The influences of facilitating conditions and social influence are also widely validated and are recognized as direct determinants of behavior intention of adoption (Venkatesh et al., 2003).

In previous studies, user perceptions are either modeled as totally independent to attributes, or defined as a function of the attributes (e.g., Luo et al., 2008). Different from prior research, my model includes both user perceived product characteristics (e.g., performance expectancy and effort expectancy), which are affected by product attributes, and contextual factors (e.g., social influence and facilitation conditions), which are independent from product attributes. According to TRA (Ajzen & Fishbein, 1980), a

person's intention to perform a behavior is jointly determined by the person's attitudes and subjective norms concerning the behavior, therefore the social influence should be taken into consideration in technology adoption studies. Similarly, the Unified Theory of Acceptance and Use of Technology (UTAUT, Venkatesh et al., 2003) also suggests that behavioral intentions can be predicted by performance expectancy, effort expectancy, social influence and facilitating conditions. In this line, it is essential to include user perceptions regarding both the product and the context.

In this study, attitude-formation perceptions are treated as latent constructs, with user ratings of the perceptions as indicator variables. As Luo et al., (2008) suggest, modeling the perceived characteristics as latent constructs (1) avoids the direct use of consumer perception ratings in the utility function, which may provide misleading results given the presence of measurement errors (Ashok et al., 2002), and (2) allows for differences in precision of ratings among individuals.

Research Design

In this section, the modeling approach is detailed, together with the development of conjoint study design, and the study procedures.

Model Development

Based on the respondents' evaluations of the product profiles in a conjoint survey, I estimate the parameters for each of the features by the Hierarchical Bayesian (HB) structural equation model. Previous research with empirical data finds strong support that individual-level HB models offer better fits and validation than comparable latent

segment models (Moore, 2004). In addition, HB methods allow more accurate estimates of individual-level parameters with fewer observations (Karniouchina et al., 2009).

I estimate the following models: Model I is the proposed model, Model II uses only the product attributes to predict the consumers' choices (i.e., a traditional conjoint model), and in Model III, only the latent constructs of user perceptions are used as explanatory variables.

Let $n = 1, 2, \ldots, N$ represent the individuals, and let $i = 1, 2, \ldots, I$ index the product. Let v_{ni} denote the (K × 1) vector of observed ratings for user perceptions related to the ith product profile; i.e., v_{ni} is the observed indicator variables. z_{ni} is the (J × 1) vector of latent constructs representing individual n's perceptions of the ith product profile. For individual n, I can write the mapping between the observed indicator variables v_{ni} and the latent constructs z_{ni} in the form of measurement equations as follows:

$$v_{ni} = \Lambda_n z_{ni} + \varepsilon_{ni} \tag{1}$$

In Equation (1), the (K × J) matrix Λ_n contains the factor loadings that map the indicator variables onto the latent constructs. The term $\varepsilon_{ni} \sim MVN(0, \Theta_n)$ represents the vector of measurement errors. It is assumed that the factor-loading matrices are invariant across individuals (i.e., $\Lambda_n = \Lambda$, for n=$1, 2, \ldots, N$), to make the factor scores comparable across individuals and to preserve the interpretability of the constructs (Ansari, Jedidi, & Jagpal, 2000; Luo et al., 2008). The (K × K) matrix Θ_n is diagonal, with the measurement error variances varying across individuals.

Let x_{jl} denote the (M × 1) vector containing the product attributes describing the *j*th profile in the *l*th choice set seen by person *n*. Then the structural equation relating the product attributes to the user perceptions for each individual is as follows:

$$z_{njl} = \delta_n + \mathrm{B}_n x_{jl} + \mu_{njl} \tag{2}$$

where δ_n denotes the (J × 1) vector of individual differences. B_n is a (J × M) coefficient matrix denoting the effects of x_{jl} on z_{njl}, and the $\mu_{njl} \sim MVN(0, \Delta_n)$ represents the disturbance terms; I allow the variance-covariance matrix Δ_n to vary across individuals.

Let P_{njl} be the probability that person *n* chooses alternative *j* out of the *l*th choice set whose elements are indexed by *m*, I then have the following equation for the proposed model (Model I):

$$P_{njl} = \frac{e^{\hat{\mathrm{A}}_n x_{njl} + \hat{\Gamma}_n z_{njl}}}{\sum_m e^{\hat{\mathrm{A}}_n x_{nml} + \hat{\Gamma}_n z_{nml}}} \tag{3}$$

In equation (3), x_{njl} is a (P × 1) vector containing the description of product attributes for the *j*th profile in the *l*th choice set seen by individual *n*, and $\hat{\mathrm{A}}_n$ is a (P × 1) vector of importance weight. z_{nml} is a (Q × 1) vector representing individual *n*'s perceptions of the *m*th profile in the *l*th choice set, and $\hat{\Gamma}_n$ is a (Q × 1) vector of importance weight.

For estimating Model II, I use only the users' latent perceptions as predictor, and do not model the relationship between perception and product attributes. The equation for user choices would be:

$$P_{njl} = \frac{e^{\hat{\Gamma}_n z_{njl}}}{\sum_m e^{\hat{\Gamma}_n z_{nml}}} \tag{4}$$

For Model III, I use only the product attributes, and the equation is as follows:

$$P_{njl} = \frac{e^{\hat{\mathrm{A}}_n x_{njl}}}{\sum_m e^{\hat{\mathrm{A}}_n x_{nml}}} \tag{5}$$

Individual choice predictions are based on a maximum utility model. Choice shares were predicted by summing individual choice probabilities over the sample.

Development of the Conjoint Product Profiles

In this study, I use mobile apps as the target software products. In addition to the importance of mobile apps in today's software market, using mobile apps as the target products in this study reduces probable biases since most of the mobile apps are new to the market. With no single dominant application in one software category on the mobile market, consumers are less affected by their existing impressions and preferences. Thus, using mobile apps as the target products in this study enables more accurate estimations of user preferences based on product attributes and relevant user perceptions.

Two types of mobile apps are chosen in this study. The first one is a note-taking app, which is a tool for increasing productivity. This type of applications is used for taking notes, prioritizing to-dos, and integrating with calendars. The other one is a messaging app, which is a personal communication tool, the type of app used for sending messages and files between mobile users. These two are among the most popular types of mobile apps (but not the most popular types of applications) that users are willing to pay for[2], and represent diverse ways in which mobile apps are used in daily life (see Figure 3.3 and Figure 3.4 for exemplified screenshots).

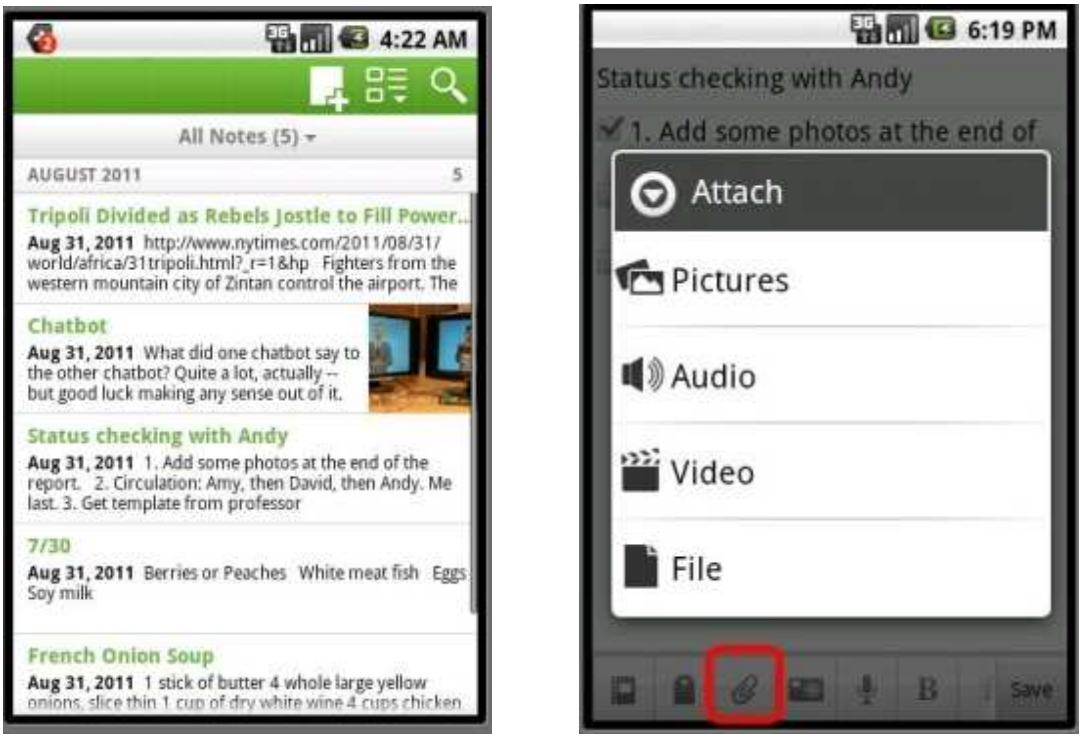

Figure 3.3. Screenshots of the Note-taking App Used in This Study

[2] According to Nielsen research (2011), productivity applications are downloaded by 21% of the past-30-day downloaders, and communication applications are downloaded by, 20% of the past-30-day downloaders.

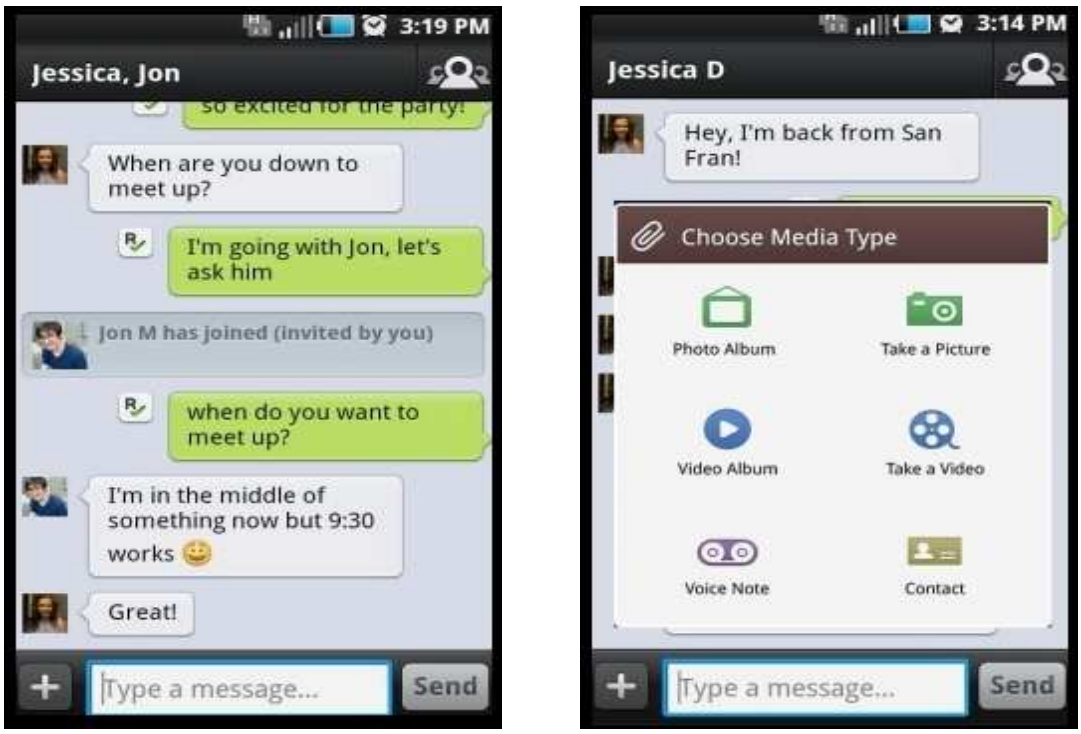

Figure 3.4. Screenshots of the Messaging App Used in This Study

The note-taking app is problem-solving oriented, and usually is a stand alone program for a single user On the other hand, the messaging app is used for leisure or communication purpose, is full of networking and interaction experiences, and needs to be used together with other users (See Figure 4 for exemplified screenshots). The two apps represent very distinct contexts for individual users' app choices. Thus, users may weight various product attributes and perceived characteristics differently when they choose the two apps with distinct purposes. The inclusion of different types of apps would enable this study to produce more generalizable results than would be possible with the use of a single app. It also exhibits the viability of applying this approach in various types of mobile apps.

I developed a set of attributes and corresponding attribute levels for the competing domains for the conjoint analysis, as shown in Table 3.1 and Table 3.2. In this study, product attributes are selected based on: (1) their importance to the end user, and (2) their relevance to user perceived characteristics (Luo et al., 2008). For example, neither customized background settings nor font and color settings are included because they do not influence the effort expectancy or performance expectancy of the app. I used $0.99 and $9.99 to represent the widely accepted price versus a less popular price, for most of the mobiles are priced at $0.99 (about 85,000 apps) and only around 850 apps are priced at $9.99. [3]

Table 3.1. Attributes (and Levels within Attributes) in the Note-taking App Study

	Category	**Attributes**	**Levels**
Vendor-side Factors	Functionality	Attachment	Present Absent
		Full-text search	Present Absent
		Tags and dates	Present Absent
		Synchronization	Present Absent
	Price	Price of the software	$9.99 $0.99
	User base	Users among friends	>=60% <20%
	Vendor Support	Support level	High Low
User-side Factors	Contextual Factors	Social influence	High Low
		Facilitating conditions	High Low

[3]Details are available at http://innumero.wordpress.com/2011/02/16/distribution-of-price-on-the-apple-application-store/, accessed in January, 2012.

Table 3.2. Attributes (and Levels within Attributes) in the Messaging App Study

	Category	Attributes	Levels
Vendor-side Factors	Functionality	Multimedia	Present Absent
		Group chat	Present Absent
		Friends	Present Absent
		Notifications	Present Absent
	Price	Price of the software	$9.99 $0.99
	User base	Users among friends	>=60% <20%
	Vendor Support	Support level	High Low
User-side Factors	Contextual Factors	Social influence	High Low
		Facilitating conditions	High Low

Because of the total number of possible combinations of levels, it is 2^9 for both the note-taking and the messaging apps, full-profile analysis is not applicable for this study. Instead, randomized tasks are used for the two experiments. The random tasks are generated by Sawtooth Software's SSI Web experimental design module with the complete enumeration strategy. The complete enumeration strategy considers all possible profiles and chooses each one so as to produce the most nearly orthogonal design for each respondent. The product profiles within each task are also kept as different as possible to ensure minimal overlap (Johnson & Orme, 1996). Accordingly, a different version of the survey was generated for each participant.

Study Design and Procedure

The survey was conducted via a web-based interface. I conducted a verbal conjoint survey; hypothetical screenshots of the focal apps are provided to depict their functionalities. Other attributes are described verbally. This approach of verbal conjoint survey is considered as efficient as a prototype conjoint survey with empirical supports (Luo et al., 2008). In order to maintain the participants' focuses on the factors I studied, and to control for other possible confounding factors (e.g., the participants' familiarity with the user interface, their preferences of the operation systems of the smartphone etc.), I adopted the verbal conjoint survey design in this study.

A mixed sample of undergraduate and graduate students from a U.S. university was used in this study. This sample was used due to their familiarity with mobile apps. All of the participants used mobile apps everyday at least three times, and owned their own smartphones.

Participants were asked to provide background information (i.e., gender, age, major, and years in college) and then to start the product evaluation. The participants were asked to imagine that they were searching for a note-taking/messaging app. The participants had an opportunity to closely view each product design before providing their preferences. Each attribute was explained with snapshots of the app. Participants received the same description of product attributes, as listed in Table 3.3.

Then, they received eight choice sets, which included three app designs as well as the option of choosing none of them[4].

[4] Choice experiments typically employ an alternative of ‘‘choose none,” ‘‘stay with current product,” or, ‘‘keep on shopping” so the respondents are not forced to choose any of the alternatives if they are

Table 3.3. Product Attributes and Descriptions

	Attribute	Description
Note-taking App	Function “Attachment”	This function allows you to attach files to the notes you create.
	Function “Search”	This function allows you to search the notes by any word(s) in the text.
	Function “Tags”	This function allows you to organize your notes by tags you assigned to each note.
	Function “Sync”	This function allows you to sync your notes across different devices and computers.
Messaging App	Function “Group chat”	This function allows you to enjoy not only one-on-one chats but also group chats with unlimited number of friends.
	Function “Multimedia”	This function allows you to send, view and share pictures and videos that you select from your existing album or right after taking them.
	Function “Friends”	This function allows you to find friends by searching their names in Friends menu, and register favorite friends so that you can easily locate them in Friends menu.
	Function “Notifications”	This function notifies you when a message has been sent, delivered, read.
Both	User base	Represents the popularity of this app.
	Vendor support level	Describes the customer services provided by the vendor. If the support level is high, the vendor maintains a user discussion forum and a FAQ database you can search for useful information. In addition, you can send questions to the vendor. The vendor will respond in 24 hours.
	Price	There is a one-time fee for this app.
	Important others’ opinions:	Describes whether someone important to you thinks you should use this app.
	Compatibility	Describes whether the app can be used on the phone you currently have.

insufficiently attractive. This allows one to model changes in the size of the overall market (Karniouchina et al., 2009).

For each choice task, the provided functions were shown to the participants, as well as the price, vendor support level and the user base information. Descriptions of different selection scenarios (different levels of social influence and facilitating conditions) were also provided. Figure 3.5 illustrates a sample task.

In this stage, I did not ask for the participants' perceptions of the products, because previous research has indicated that prompting inferences may significantly alter consumers' preferences (Huber & McCann, 1982). Therefore, the perceptions are designed to be collected at the next stage.

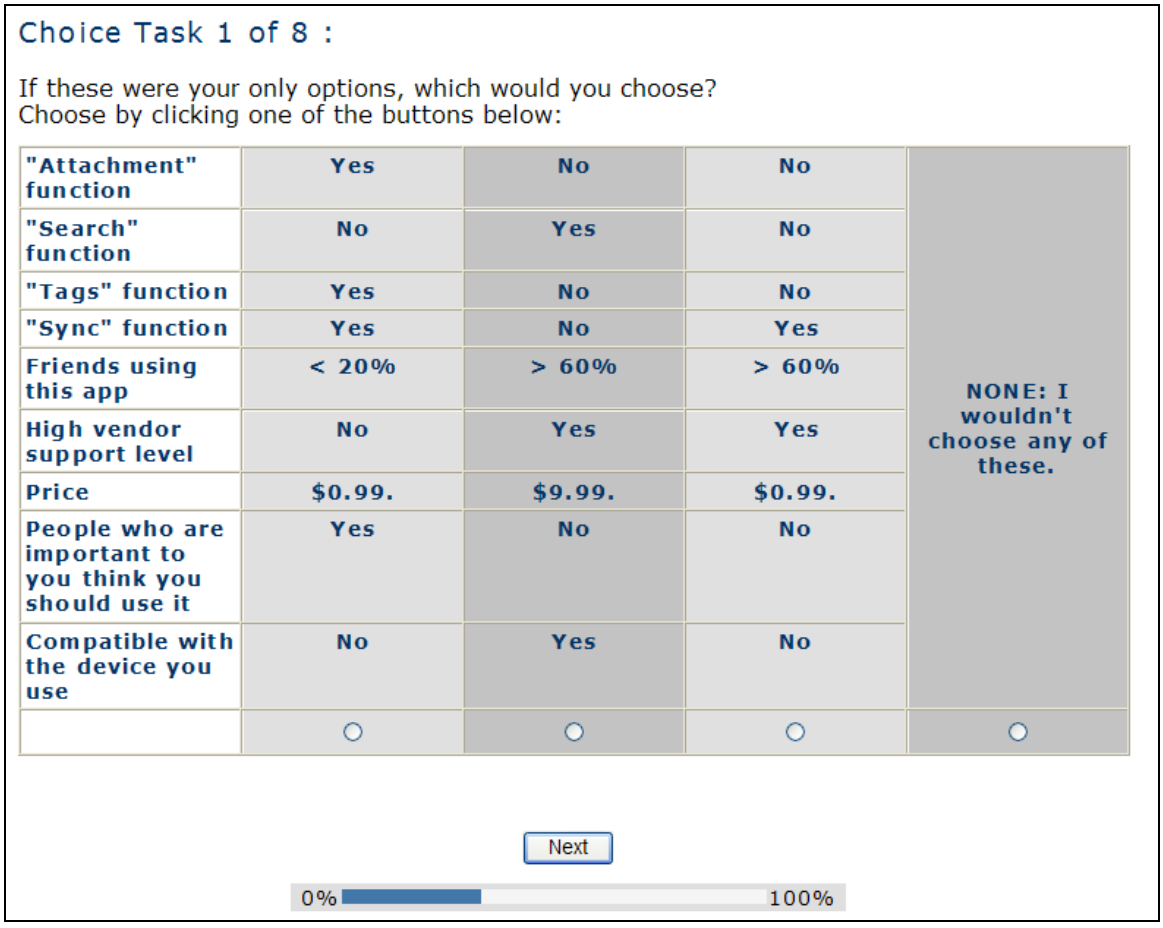

Figure 3.5. A Sample Choice Task

In the next stage, I collected the participants' perceptions of four product profiles. The same set of four product profiles was shown to all the participants. Based on the description, participants were asked questions about performance expectancy and effort expectancy toward each product profile with various combinations of functionalities. Only product functionalities are manipulated in this stage, because in our model set up, users' performance expectancy and effort expectancy are affected by only product functionalities. Performance expectancy and effort expectancy were measured using established scales by Venkatesh et al., (2003). Detailed items are listed in Appendix C. The study flow is shown in Figure 3.6.

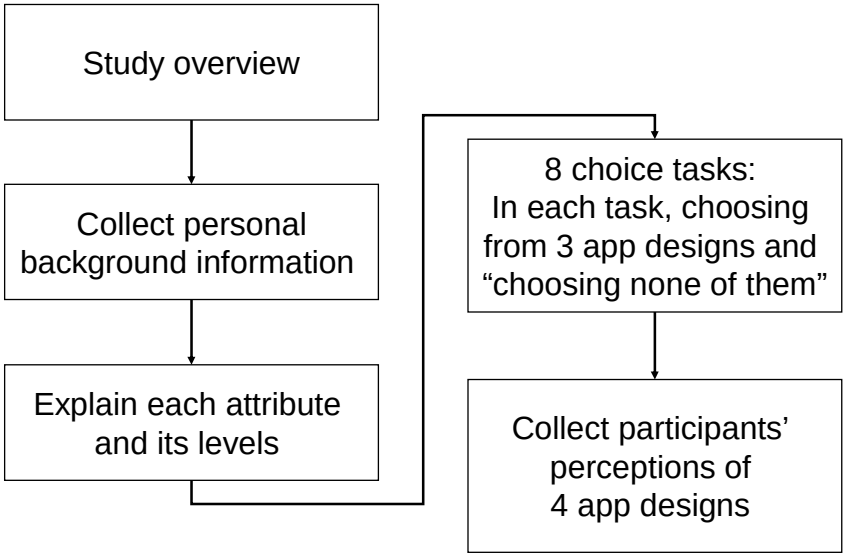

Figure 3.6. Study Flow of the Software Choice Study

Data Analyses and Results

In this section, I illustrate the empirical testing results of the two apps. I also compare the predictive power of the proposed model with the two benchmark models.

Note-taking App Study

The data for the study on the note-taking app were collected from 105 participants from the targeted sample pool. Among the participants, 65.1% are male and 34.9% are female; the average age is 25.16, and the average number of years in college is 3.81. I used data from six randomized choice tasks for calibration, and used the other two fixed choice tasks as holdout choice sets for evaluation.

Table 3.4 summarizes the in-sample fit. To assess relative posterior fit, I compare the posterior probability of the data conditional on each model, or the log marginal density (Newton & Raftery, 1994). The log marginal density is approximated by the harmonic mean of the likelihoods of the data from the posterior distribution across MCMC sampling iterations. Larger values (i.e., less negative values) of the log marginal density indicate a preferred model. Note also that the log marginal density includes an automatic penalty for a model with more parameters (Rossi, Allenby, & McCulloch, 2005), and therefore log marginal density is suitable for comparing the relative fit of the model and the data.

By comparing the log marginal density of the models, it shows that the proposed model (i.e., Model I) fits the data better (log marginal density = -269.562) than the other two benchmarking models (log marginal density = -310.305 and -790.125, respectively).

Table 3.4. In-sample Fit (Note-taking App)

	Model I	**Model II**	**Model III**
Log Marginal Density	-269.562	-310.305	-790.125

Table 3.5 shows the calibration results. The functions of editing tags and synchronization in general, appear to have the most prominent effects on users' performance expectancy, followed by the function of search. On the other hand, the function of editing tags seems to have the least influence on users' effort expectancy. However, the effects of other functions on effort expectancy estimated by Model I and Model III are not conclusive. As for the purchase intention, in general, facilitating conditions are the most important consideration, followed by price; facilitating conditions and price appear to have comparable weights. In general, the functions of attachment and search are also relatively important in affecting users' choice decisions. With such information, the app vendor can make a better decision on whether they should include the function or not. The app vendor can also segment the population using clustering analysis based on the individual-level coefficients.

The coefficients of variables can take either sign, since users may have diverse preferences. Each of these coefficients is given an independent normal distribution with mean and standard deviation that are estimates. The coefficients for the function of attachment, price and facilitating conditions have the same sign for all users, with only their magnitudes differing over users. However, the coefficients for other factors vary greatly across users; for example, the standard deviation of the coefficient for performance expectancy and effort expectancy are high, indicating that the coefficient

Table 3.5. Summary of Parameter Estimates (Note-taking App)

	Model I			Model II	Model III		
	Performance Expectancy	Effort Expectancy	Purchase Intention	Purchase Intention	Performance Expectancy	Effort Expectancy	Purchase Intention
Constant	0.726 (0.077)	-2.258 (0.050)			-0.223 (0.066)	-2.369 (0.071)	
Function: Attachment	0.325 (0.055)	-2.064 (0.049)	3.466 (0.910)	2.580 (0.836)	-2.926 (0.079)	0.504 (0.067)	--
Function: Search	1.929 (0.062)	-1.463 (0.079)	3.870 (0.688)	2.888 (0.542)	2.800 (0.081)	2.554 (0.065)	--
Function: Tags	3.125 (0.061)	1.250 (0.067)	0.493 (0.932)	0.851 (0.638)	6.471 (0.068)	0.016 (0.053)	--
Function: Sync	3.125 (0.070)	1.748 (0.092)	1.997 (0.991)	1.363 (0.853)	6.192 (0.079)	-1.086 (0.060)	--
User base	--	--	1.421 (1.182)	1.063 (0.632)	--	--	--
Vendor support level	--	--	0.918 (1.253)	0.842 (0.993)	--	--	--
Price	--	--	-6.285 (3.167)	-4.516 (1.914)	--	--	--
Social Influence	--	--	-0.548 (1.064)	-0.309 (0.732)	--	--	--
Facilitating Conditions	--	--	6.529 (2.552)	4.517 (2.042)	--	--	--
Performance Expectancy	--	--	0.109 (0.585)	--	--	--	-0.002 (0.102)
Effort Expectancy	--	--	0.081 (0.433)	--	--	--	0.041 (0.093)

Note: Population posterior standard deviations appear in parentheses.

vary significantly in the population. Observation of the standard deviations of the coefficients indicates that there is considerable variation in the individual preferences that vanished by data aggregation.

The means and standard deviation of these coefficients provide further information on the share of the population that places a positive value on a factor and the share that places a negative value. For example, in Model I the distribution of the coefficient for the function of editing tags obtains an estimated mean of 0.493 and estimated standard deviation of 0.932, such that, about 63% of the distribution is above zero and 37% below. Also in Model I, the coefficients for performance expectancy (mean = 0.109; standard

deviation = 0.585) show while 54% of the users prefer mobile apps with high performance expectancy, 46% of the users have different preferences. One of the possible explanations is that some users would prefer mobile apps with only minimum essential function and less performance expectancy given the hardware limitations of a mobile device. The coefficients for effort expectancy (mean = 0.081; standard deviation = 0.433) show that 53% of the users prefer mobile apps with high effort expectancy. It is possible that the users prefer mobile apps with more functions that increase effort expectancy.

Table 3.6 shows the holdout choice set validation results. I compare the percentage of time that the model correctly predicted each individual's choices resulting from estimated utility functions. The validation is based on two holdout choice sets of three app designs and the option of choosing none. Individual choices are simulated using a maximum utility choice rule. The results of individual-level hit rates show that the prediction hit rate of the proposed model (0.657) is higher than the benchmark models (0.629 and 0.238). The prediction validation is also done at the aggregate-level, by computing the mean absolute deviation (MAD) between predicted and actual choice shares, over all alternatives and choice sets. The results show that the proposed model validates better than the other two models.

Table 3.6. Prediction Result of Holdout Choice Sets (Note-taking App)

	Model I	**Model II**	**Model III**
Holdout Hit Rate	0.657	0.629	0.238
Mean Absolute Deviation	0.063	0.072	0.255

Messaging App Study

The data for the study of the messaging app were collected from 96 participants from the targeted sample pool. Among the participants, 67.3% are male and 32.7% are female; the average age is 23.72, and the average year in college/university is 3.57. Similarly, six randomized choice tasks were used for calibration, and the other two fixed choice tasks were used as holdout choice set for prediction validation.

For the messaging app, the proposed model (i.e., Model I) fits the data better (log marginal density = -247.796) than the other two benchmarking models (log marginal density = -304.863 and -685.277), according to the log marginal density of the models shown in Table 3.7. The results again, validate the value of incorporating user perceptions in choice-based conjoint studies.

In the context of selecting messaging apps, the function of editing friend list has the most negative effect on users' performance expectancy, while the function of group chat has the most positive influence. In terms of effort expectancy, the function of editing friend list appears to be the most prominent factor in Model I, while the function of multi-media is the strongest factor estimated by Model III. For purchase intention, facilitating conditions shows the highest importance among all the attributes and perceptions, followed by price; the importance of facilitating conditions and price are rather comparable. The function of multimedia is also relatively important in users' choice decision. Note also that the user base appears to be more important than some functions, showing the significance of user base for a communication-oriented app (see Table 3.8).

Table 3.7. In-sample Fit (Messaging App)

	Model I	**Model II**	**Model III**
Log Marginal Density	-247.796	-304.863	-685.277

It is again observed that users' considerations over the factors vary to a great extent toward the messaging app, according to the estimated means and standard deviations of the coefficients. Only the coefficients for facilitating condition have the same sign for all users, with their magnitudes differing over users. For example in Model I, the coefficients for the multimedia function, notification function, social influence, performance expectancy and effort expectancy indicate that these coefficients vary greatly in the

Table 3.8. Summary of Parameter Estimates (Messaging App)

	Model I			Model II	Model III		
	Performance Expectancy	Effort Expectancy	Purchase Intention	Purchase Intention	Performance Expectancy	Effort Expectancy	Purchase Intention
Constant	-4.641 (0.032)	-2.126 (0.032)			-1.803 (0.057)	1.298 (0.072)	
Function: Group chat	5.154 (0.036)	2.140 (0.032)	1.862 (1.787)	1.703 (0.869)	1.515 (0.063)	-0.128 (0.072)	--
Function: Multimedia	-4.159 (0.033)	-2.077 (0.033)	2.240 (2.309)	1.778 (1.078)	-2.895 (0.061)	-1.476 (0.060)	--
Function: Friends	-8.957 (0.029)	-3.885 (0.032)	1.160 (0.763)	1.028 (0.840)	-2.904 (0.069)	-0.163 (0.049)	--
Function: Notifications	-4.081 (0.028)	-1.957 (0.030)	0.917 (1.100)	0.973 (0.848)	-2.270 (0.052)	0.594 (0.064)	--
User base	--	--	1.969 (0.896)	1.665 (0.904)	--	--	--
Vendor support level	--	--	0.971 (0.745)	0.713 (0.480)	--	--	--
Price	--	--	-5.013 (3.171)	-3.576 (1.756)	--	--	--
Social Influence	--	--	0.344 (1.164)	0.500 (0.624)	--	--	--
Facilitating Conditions	--	--	5.105 (2.183)	3.767 (1.375)	--	--	--
Performance Expectancy	--	--	0.023 (0.393)	--	--	--	0.085 (0.221)
Effort Expectancy	--	--	-0.229 (0.601)	--	--	--	-0.040 (0.139)

Note: Posterior standard deviations are in parentheses

population. For example, according to the distribution of the coefficient estimated using Model I, users exhibit diverse preferences on performance expectancy (mean = 0.023; standard deviation = 0.393) and effort expectancy (mean = -0.229; standard deviation = 0.601); 50% of them prefer mobile apps perceived as high performance expectancy positively, and 42% weighted prefer mobile apps with high effort expectancy. The estimation results of the coefficients for performance expectancy and effort expectancy with messaging apps are similar to those with note-taking apps.

Table 3.9 shows the validation results using holdout choice sets. The comparison of the individual-level hit rate validation also shows that the proposed model can better predict users' choices. The prediction hit rate of the proposed model (0.582) is higher than the benchmark models (0.552 and 0.370). According to the MAD of predicted versus actual choice shares, the proposed model validates better (MAD = 0.100) than the other two models at the aggregate-level as well (MAD = 0.122 and 0.128, respectively).

Discussion

These findings offer several implications for research. First, the study results show that users take a dual information processing strategy in choosing software products. Prior research has identified the distinction of the two processing strategies, and the decision context in which each strategy would be used (e.g., Mantel & Kardes, 1999; Sanbonmatsu & Fazio, 1990). The study further suggests that the two strategies are not used solely in the decision process, in light of the importance of personal construct theory. For example, attribute-based decisions are made when users attend to details and

Table 3.9. Prediction Result of Holdout Choice Sets (Messaging App)

	Model I	**Model II**	**Model III**
Holdout Hit Rate	0.582	0.552	0.370
Mean Absolute Deviation	0.100	0.122	0.128

are motivated to form accurate judgments, and the judgments are also made on the basis of personal idiosyncrasies, which represent the way individuals make sense of the world.

Second, the importance of user perceptions cannot be overlooked, even though the relative importance of product attributes are much greater than user perceptions in the context of this study. The results show that users' perceptions are not independent from product attributes. The inclusion of user perceptions can help us more accurately capture the total effect of product attributes, and provide insights into how product designs can alter user perceptions. For example, a tool for custom reporting of a software product may induce positive performance expectancy but negative effort expectancy, due to the complexity of function. In this context, a model without both product attributes and user perceptions may not be able to provide insights on how to improve the product design to promote user preference of the product.

For practitioners in the product design area, this study provides a generalizable method to incorporate user perceptions into the new product design process. With the ability to estimate the relative importance of product attributes, and the effect of product attributes on user perceptions, the total effect of product attributes can be more accurately estimated. The results can assist software vendors in determining the optimal combination of product features to better fulfill the needs of the majority of the targeted users.

Conclusion

In this study, I develop a model to incorporate the impacts of the perceived product characteristics and user perceptions in explaining users' packaged software choices, using a choice-based conjoint study. Specifically, I model the effects of product attributes, together with user perceived product characteristics and contextual factors, on users' preferential choices. The influences of product attributes on users' perceived product characteristics are also examined. With randomized choice tasks of choosing a note-taking app or a messaging app, and the collection of additional data on user perceptions, I demonstrate the proposed model can better explain and predict users' product choices, in terms of the in-sample fit and the holdout prediction hit rate. Compared to prior research, which includes only product attributes on product evaluation, or studies that focus only on user perceptions in adoption decisions, my approach can provide a better understanding of how product attributes, price, vendor support level, size of user base, and user perceptions jointly contribute to consumers' software selection decisions.

This study contributes to the IS literature by providing insights into consumers' decision processes of packaged software selections. While prior IS research mainly focuses on users' perceptions in explaining user behavior, the results of this study suggests the importance of the direct and indirect effects of product attributes. By taking the effect of product attributes into consideration, researchers can better explain and predict users' software selection decisions. In addition, this study contributes to software product design literature by showing how the external stimuli affect users' perceptions, and then lead to users' software choice decisions. While user perceptions are generally assumed to mediate the effects of product attributes, I provide empirical evidence of the

mediating effect of user perceptions on users' software selections, and further, I offer insights into how product design will affect user perceptions.

This study contributes to the literature by incorporating both objective attributes and user perceptions in the choice-based conjoint study. While prior literature has suggested such an approach in rating-based conjoint designs, the parameter estimation in choice-based design provides greater ability to model whether a customer makes a purchase from a product class or not, and the study context is more realistic to consumers' daily product choices. While choice-based design is now the most popular and widely adopted conjoint design, the study suggests a new approach of incorporating user perceptions into this research stream.

In addition, the approach I propose in this study includes two different types of user perceptions: perceptions independent from product attributes (e.g., contextual factors) and perceptions affected by product attributes (e.g., performance expectancy and effort expectancy). Although I controlled the contextual factors as part of the product profile evaluated by users, my approach can be applied to studies that collect users' perceptions of the context and other factors independent from product attributes. This approach is therefore flexible in applying to various conjoint research designs.

However, this study also has several limitations that should be considered when interpreting the results. First, the results derive from studies that involve a sample of volunteer participants. Although the participants can reasonably represent the user group of mobile apps, I cannot rule out potential self-selection biases completely. Therefore, the findings should be generalized only very cautiously. Second, the study design limits the ability to address potential interaction effects among product attributes, due to the

concerns of the number of choice tasks of each participant. The main purpose of the study is to compare the model incorporating both product attributes and user perceptions, to the model with product attributes only and the model with user perceptions only. While examining the main-effects-only model is sufficient for the empirical investigation, including interaction effects in the model may provide more information toward users' product choice decisions. Third, performance expectancy and effort expectancy are used in this study to represent the perceptions affecting users' package software choices. While prior literature has identified performance expectancy and effort expectancy as the most prominent perceived factors in users' technology adoption decisions (Venkatesh et al., 2003), a broader set of user perceived product characteristics can be further examined in future studies.

These limitations suggest several other important research directions. For example, researchers should examine user perceived product characteristics affecting dynamic product choices, such as look-and-feel, perceived usability, perceived observability, and perceived learnability. Similarly, other contextual factors can be also incorporated; e.g., triability and subjective norms. In addition, mobile apps only represent only one category of packaged software products; further research could examine the applicability of my approach using different types of packaged software (e.g., such as operating systems, graphic design and process, statistics, computer-aided design) or various user groups. Further study of interaction effects of product attributes and user perceptions also deserves attention.

Appendix C: Question Items Included in the Study

Performance Expectancy (Venkatesh et al., 2003)

PE-1: I would find the application useful in my daily life.
PE-2: Using the application enables me to accomplish tasks/communications more quickly.
PE-3: Using the application increases my productivity.

Effort Expectancy (Venkatesh et al., 2003)

EE-1: It would be easy for me to become skillful at using the application.
EE-2: I would find the application easy to use.
EE-3: Learning to operate the application is easy for me.

References

Adipat, B., Zhang, D., & Zhou, L. 2011. The effects of tree-view based presentation adaptation on mobile web browsing. ***MIS Quarterly***, 35(1): 99-121.

Agarwal, R., & Prasad, J. 1999. Are individual differences germane to the acceptance of new information technologies? ***Decision Sciences***, 30(2): 361-391.

Ajzen, I. 1991. The theory of planned behavior. ***Organizational Behavior and Human Decision Processes***, 50: 179-211

Ajzen, I., & Fishbein, M. 1980. ***Understanding Attitudes and Predicting Social Behavior***. Englewood Cliffs, NJ: Prentice-Hall.

Alarcon, R. 2006. Analysis and design of mobile collaborative applications using contextual elements. ***Computing and Informatics***, 25(6): 469-496.

Alba, J.W., & Hutchinson, J.W. 1987. Dimensions of consumer expertise. ***Journal of Consumer Research***, 13(4): 411-454.

Anderson, N. 1977. Functional measurement and psychophysical judgment. ***Psychological Review***, 77(3): 153-170.

Anderson, E.E. 1990. Choice models for the evaluation and selection of software packages. ***Journal of Management Information Systems***, 6(4): 123-138.

Ansari, A., Jedidi, K., & Jagpal, S. 2000. A hierarchical Bayesian methodology for treating heterogeneity in structural equation models. ***Marketing Science***, 19 (4): 328-347.

Ashok, K., Dillon, W.R., & Yuan, S. 2002. Extending discrete choice models to incorporate attitudinal and other latent variables. ***Journal of Marketing Research***, 39 (1): 31-46.

Bakos, Y., & Brynjolfsson, E. 1999. Bundling information goods: Pricing, profits, and efficiency. ***Management Science***, 45 (12): 1613-1630.

Bevan, N. 1995. Measuring usability as quality of use. ***Software Quality Journal***, 4 (2): 115-150.

Biel, B., Grill, T., & Gruhn, V. 2010. Exploring the benefits of the combination of a software architecture analysis and a usability evaluation of a mobile application. ***Journal of Systems and Software***, 83(11): 2031-2044.

Brynjolfsson, E., & Kemerer, C.F. 1996. Network externalities in microcomputer software: An econometric analysis of the spreadsheet market. ***Management Science***, 42(12): 1627-1647

Calisira, F., & Calisira, F. 2004. The relation of interface usability characteristics, performance expectancy, and effort expectancy to end-user satisfaction with enterprise resource planning (ERP) systems. ***Computers in Human Behavior***, 20(4): 505-515.

Carmel E., & Sawyer, S. 1998. Packaged software development teams: What makes them different? ***Information Technology & People***, 11(1): 6-17.

Cattin, P., & Wittink, D.R. 1982. Commercial use of conjoint analysis: A survey. ***Journal of Marketing***, 46(3): 44-53.

Charland, A., & Leroux, B. 2011. Mobile application development: Web vs. native. ***Communications of the ACM***, 54(5): 49-53.

Chau, P.Y.K. 1995. Factors used in the selection of packaged software in small businesses: Views of owners and managers. ***Information & Management***, 29(2): 71-78.

Chau, P.Y.K., & Hu, P.J. 2001. Information technology acceptance by individual professionals: A model comparison approach. ***Decision Sciences***, 32(4): 699-719.

Cheng., H.K., Sims, R.R., & Teegen, H. 1997. To purchase or to pirate software: An empirical study. ***Journal of Management Information Systems***, 13(44): 49-60.

Cheng, H.K., & Tang, Q.C. 2010. Free trial or no free trial: Optimal software product design with network effects. ***European Journal of Operational Research***, 205(2): 437-447.

Cheng, Y.-M. 2011. Antecedents and consequences of e-learning acceptance. ***Information Systems Journal***, 21(3): 269-299.

Davis, F.D. 1989. Performance expectancy, effort expectancy, and user acceptance of information technology. ***MIS Quarterly***, 13(3): 319-339.

Davis, F.D., Bagozzi, R.P., & Warshaw, P.R. 1989. User acceptance of computer technology: A comparison of two theoretical models. ***Management Science***, 35(8): 982-1003.

Duan, W., Gu, B., & Whinston, A.B. 2009. Informational cascades and software adoption on the Internet: An empirical investigation. ***MIS Quarterly***, 33(1): 23-48.

Eliasson, J., Pargman, T.C., Nouri, J., Spikol, D., & Ramberg, R. 2011. Mobile devices as support rather than distraction for mobile learners: evaluating guidelines for design. ***International Journal of Mobile and Blended Learning***, 3(2): 1-15.

Elrod, T., Louviere, J., & Davey, K. 1992. An empirical comparison of ratings-based and choice-based conjoint models. ***Journal of Marketing Research***, 24 (3): 368-377.

Farrell, J., & Saloner, G. 1985. Standardization, compatibility, and innovation. ***RAND Journal of Economics***, 16(1): 70-83.

Faullant, R., Fuller, J., & Matzler, K. 2012.Mobile audience interaction – Explaining the adoption of new mobile service applications in socially enriched environments. ***Engineering Management Research***, 1(1): 59-76.

Feit, E.M., Beltramo, M.A., & Feinberg, F.M. 2010. Reality check: Combining choice experiments with market data to estimate the importance of product attributes. ***Management Science***, 56(5): 785-800.

Fishburn, P.C. 1970. ***Utility Theory for Decision Makin***g. New York: John Wiley & Sons.

Gallaugher, J.M., & Wang, Y.-M. 2002. Understanding network effects in software markets: Evidence from web server pricing. ***MIS Quarterly***, 26(4): 303-327.

Gefen, D., & Straub, D.W. 1997. Gender differences in the perception and use of e-mail: An extension to the technology acceptance model. ***MIS Quarterly***, 21(4), 389-400.

Gerstner, E. 1985. Do higher prices signal higher quality? ***Journal of Marketing Research***, 22(2): 209-215.

Green, P.E., & Rao, V.R. 1971. Conjoint measurement for quantifying judgmental data. ***Journal of Marketing Research***, 8(3): 355-363.

Green, P.E., & Srinivasan, V. 1990. Conjoint analysis in marketing: New developments with implications for research and practice. ***The Journal of Marketing***, 54(4): 3-19.

Green, P.E., Krieger, A.M., & Wind, Y. 2001. Thirty years of conjoint analysis: Reflections and prospects. ***Interfaces***, 31(3): S56-S73

Halme, M., & Kallio, M. 2011. Estimation methods for choice-based conjoint analysis of consumer preferences. ***European Journal of Operational Research***, 214(1): 160-167.

Holzer, A., & Ondrus, J. 2011. Mobile application market: A developer's perspective. ***Telematics and Informatics***, 28(1): 22-31.

Homburg, C., Koschate, N., & Hoyer, W.D. 2005. Do satisfied customers really pay more? A study of the relationship between customer satisfaction and willingness to pay. ***Journal of Marketing***, 69(2): 84-96.

Howcroft, D., & Light, B. 2006. Reflections on issues of power in packaged software selection. ***Information Systems Journal***, 16(3): 215-235.

Hu, P.J., Chau, P.Y.K., Sheng, O.R.L., & Tam, K.Y. 1999. Examining the technology acceptance model using physician acceptance of telemedicine technology. ***Journal of Management Information Systems***, 16(2): 91-112.

Huang, J.-H., & Chen, Y.-F. 2006. Herding in online product choice. ***Psychology and Marketing***, 23(5): 413-428.

Huber, J., & McCann, J. 1982. The impact of inferential beliefs on product evaluations. ***Journal of Marketing Research***, 19 (3): 324-333.

Im, S., Bayus, B.L., & Mason, C.H. 2003. An empirical study of innate consumer innovativeness, personal characteristics, and new-product adoption behavior. ***Journal of the Academy of Marketing Science***, 31(1): 61-73.

Iyengar, R., Van den Bulte, C., & Valente, T.W. 2011. Opinion leadership and social contagion in new product diffusion. ***Marketing Science***, 30(2): 195-212.

Jacoby, J. 1976. Consumer psychology: An octennium. ***Annual Review of Psychology***, 27: 331-359.

Johnson, R.M., & Orme, B. 1996. How many questions should you ask in choice-based conjoint studies? ***Sawtooth Software Research Paper Series***. Sequim, WA: Sawtooth.

Karniouchina, E.V., Moore, W.L., van der Rhe, B., & Verma, R. 2009. Issues in the use of ratings-based versus choice-based conjoint analysis in operations management research. ***European Journal of Operational Research***, 197(1): 340-348.

Kassarjian, H. H. 1982. Consumer psychology. ***Annual Review of Psychology***, 33: 619-649.

Katz, M.L., & Shapiro, C. 1985. Network externalities, competition, and compatibility. ***American Economic Review***, 75(3): 424-440.

Keeney, R.L., & Raiffa, H. 1976. ***Decisions with Multiple Objectives: Preferences and Value Tradeoffs***. New York: John Wiley & Sons.

Kekre, S., Krishnan, M.S., & Srinivasan, K. 1995. Drivers of customer satisfaction for software products: Implications for design and service support. ***Management Science***, 41(9): 1456-1470.

Kelly, G.A. 1970. A brief introduction to personal construct theory. In D. Bannister (ed.), ***Perspectives in Personal Construct Theory***. London: Academic Press.

Koufaris, M. 2002. Applying the technology acceptance model and flow theory to online consumer behavior. ***Information Systems Research***, 13(2): 205-223.

Lai, V.S., Trueblood, R.P., & Wong, B.K. 1999. Software selection: A case study of the application of the analytical hierarchical process to the selection of a multimedia authoring system. ***Information & Management***, 36(4): 221-232.

Lai, V.S., Wong, B.K., & Cheung, W. 2002. Group decision making in a multiple criteria environment: A case using the AHP in software selection. ***European Journal of Operational Research***, 137(1): 134-144.

Lee, Y.E., & Benbasat, I. 2004. A framework for the study of customer interface design for mobile commerce. ***International Journal of Electronic Commerce***, 8(3): 79-102.

Liberatore, M.J., & Pollack-Johnson, B. 2003. Factors influencing the usage and selection of project management software. ***IEEE Transactions on Engineering Management***, 50(2): 164-174.

Louviere, J.J., & Woodworth, G. 1983. Design and analysis of simulated consumer choice or allocation experiments: An approach based on aggregate data. ***Journal of Marketing Research***, 20(4): 350-367.

Lucas, H.D. Jr., Walton, E.J., & Ginzberg, M.J. 1988. Implementing packaged software. ***MIS Quarterly***, 12(4): 537-549.

Luce, D., & Tukey, J. 1964. Simultaneous conjoint measurement: A new type of fundamental measurement. ***Journal of Mathematical Psychology***, 1(1): 1-27.

Luo, L., Kannan, P.K., & Ratchford, B.T. 2008. Incorporating subjective characteristics in poduct design and evaluations. ***Journal of Marketing Research***, 45(2): 182-194.

Maheswaran, D., Mackie, D.M., & Chaiken, S. 1992. Brand name as a heuristic cue: The effects of task importance and expectancy confirmation on consumer judgment. ***Journal of Consumer Psychology***, 1(4): 317-336.

Mantel, S.P., & Kardes, F.R. 1999. The role of direction of comparison, attribute-based processing, and attitude-based processing in consumer preference. ***Journal of Consumer Research***, 25(4): 335-352.

Marzocchi, G.L., Brasini, S., & Rimessi, M. 2003. New product development in the software industry: The role of conjoint analysis. In A. Gustafsson; A. Herrmann; and F. Huber (eds.), ***Conjoint Measurement: Methods and Application***. (pp. 161-186).

Mathieson, K. 1991. Predicting user intentions: Comparing the technology acceptance model with the theory of planned behavior. ***Information Systems Research***, 2(3): 173-191.

Meyer, R.J., & Sathi, A. 1985. A multiattribute model of consumer choice during product learning. ***Marketing Science***, 4(1): 41-61.

Moore, G.C., & Benbasat, I. 1991. Development of an instrument to measure the perceptions of adopting an information technology innovation. ***Information Systems Research***, 2(3): 192-222.

Moore, W. 2004. A cross-validity comparison of ratings-based and choice-based conjoint analysis models. ***International Journal of Research in Marketing***, 21(3): 299-312.

Nam, S., Manchanda, P., & Chintagunta, P.K. 2010. The effect of signal quality and contiguous word of mouth on customer acquisition for a video-on-demand service. ***Marketing Science***, 29(4): 690-700.

Newton, M.A., & Raftery, A.E. 1994. Approximating Bayesian inference with the weighted likelihood boostrap. ***Journal of the Royal Statistical Societ*****y, *Series B (Methodology)***, 56 (1): 3-48.

Nielsen Report. 2011. Play before work: Games most popular mobile app category in U.S. http://blog.nielsen.com/nielsenwire/online_mobile/games-most-popular-mobile-app-category (Accessed at July 6, 2011).

Nielsen, J. 1993. ***Usability Engineering***. Boston, MA: AP Professional.

Park, C.W., Hughes, R.W., Thukral, V., & Friedmann, R. 1981. Consumers' decision plans and subsequent choice behavior. ***Journal of Marketing***, 45(2): 33-47.

Pitt, L.F., Parent, M., Junglas, I., Chan, A., & Spyropoulou, S. 2011. Integrating the smartphone into a sound environmental information systems strategy: Principles, practices and a research agenda. ***Journal of Strategic Information Systems***, 20(1): 27-37.

Quaddus, M., & Hofmeyer, G. 2007. An investigation into the factors influencing the adoption of B2B trading exchanges in small businesses. ***European Journal of Information Systems***, 16: 2-2-215.

Rogers, E.M. 1983. ***Diffusion of Innovations***, (Third Edition), New York, NY: The Free Press.

Rossi, P., Allenby, G., & McCulloch, R. 2005. ***Bayesian Statistics and Marketing***. Hoboken, NJ: John Wiley & Sons.

Sanbonmatsu, D.M., & Fazio, R.H. 1990. The role of attitudes in memory-based decision making. ***Journal of Personality and Social Psychology***, 59(4): 614-622.

Shiv, B., Carmon, Z., & Ariely, D. 2005. Placebo effects of marketing actions: Consumers may get what they pay for. ***Journal of Marketing Research***, 45(12): 383-393.

Srinivasan, V., Lovejoy, W.S., & Beach, D. 1997. Integrated product design for marketability and manufacturing. ***Journal of Marketing Research***, 34 (1): 154-163.

Tam, K.Y. 1996. Dynamic price elasticity and the diffusion of mainframe computing. ***Journal of Management Information Systems***, 13(2): 163-183.

Taylor, S., & Todd, P.A. 1995. Understanding information technology usage: A test of competing models. ***Information Systems Research***, 6(2): 144-176.

Tellis, G.J., Yin, E., & Hiraj, R. 2009. Does quality win? Network effects versus quality in high-tech markets. ***Journal of Marketing Research***, 46(2): 135-149.

Thompson, S.A., & Sinha, R.K. 2008. Brand communities and new product adoption: The influence and limits of oppositional loyalty. ***Journal of Marketing***, 72(6): 65-80.

Tiwana, A., & Bush, A.A. 2007. A comparison of transaction cost, agency, and knowledge-based predictors of IT outsourcing decisions: A U.S.-Japan cross-cultural field study. ***Journal of Management Information Systems***, 24(1): 259-300.

Tversky, A. 1969. Intransitivity of preference. ***Psychology Review***, 76(1): 31-48.

Tversky, A., Sattath, S., & Slovic, P. 1988. Contingent weighting in judgment and choice. ***Psychological Review***, 95(3): 371-384.

Tybout, A.M., & Hauser, J.R. 1981. A marketing audit using a conceptual model of consumer behavior: Application and evaluation. ***Journal of Marketing***, 45(3): 82-101.

Venkatesh, V. 2000. Determinants of effort expectancy: Integrating control, intrinsic motivation, and emotion into the technology acceptance model. ***Information Systems Research***, 11(4): 342-365.

Venkatesh, V., Morris, M.G., Davis, G.B, & Davis, F.D. 2003. User acceptance of information technology: Toward a unified view. ***MIS Quarterly***, 27(3): 425-478.

Wittink, D.R., & Cattin, P. 1989. Commercial use of conjoint analysis: An update. ***Journal of Marketing***, 53(3): 91-96.

CHAPTER 4

EXAMINING FIRMS' GREEN INFORMATION TECHNOLOGY PRACTICES

Introduction

Green information technology practices refer to the systematic efforts by firms to incorporate ecological-friendly principles and energy-efficient operations into the technology lifecycle (including design, production, purchase, utilization, and disposal) for environmental preservations (Hedwig, Malkowski, & Neumann, 2009, Molla, Cooper, & Pittayachawan, 2009; Dedrick, 2010). To practice green, firms need to select technology products (e.g., hardware, software) and conduct technology-related operations with an explicit focus on product stewardships and environmental preservation (Boudreau, Chen, & Huber, 2007; Molla et al., 2009; Chen, Watson, Boudreau, & Karahanna, 2009). Green IT practices have become an increasingly crucial integral of the global sustainability movement for meeting the needs of present generations without compromising the ability to satisfy those of future generations (Shrivastava, 1995).

Information technology often consumes substantial resources and can produce wastes and environmental hazards; thus, firms' practices are now under increasing scrutiny by the industry, the government, and the society as a whole (Banerjee, 2002; Bansal & Roth, 2000, Butler, 2011; Dedrick, 2010). For example, industry self-

regulations become more restrictive regarding the parts, methods, or processes that IT manufacturers use by holding them accountable for safe, environmental friendly manufacturing operations, disposals, and recycles (Siegel, 2009). Many governments establish laws and regulations to encourage and foster environmental-friendly technology and operations by firms. For example, the Federal Energy Carbon Offset Plan entails cap-and-trade and tax credits to further green IT initiatives (Ruth, 2009). Energy consumption reductions, including those for large data centers and sophisticated processing facilities, are constantly monitored for efficiency and compliance (Dedrick, 2010). Furthermore, the general public's awareness of environmental sustainability is rising as well; consumers around the world are becoming more cautious about important issues that affect environmental protection and preservation (Dedrick, 2010).

In addition to the external pulls by industry, government and society, green practices can be propelled by internal pushes within the firm, such as efficiency improvement, legal risk avoidance, social cost mitigation, and favorable branding (Ambec & Lanoie, 2008; Bansal & Roth, 2000; Siegel, 2009). For example, energy consumption normally constitutes a major source of cost in the firm's technology utilization; the increasing electricity cost, combined with the ever-expanding power density of computing and technology infrastructure, now forces firms to consider energy efficiency in their technology choices and operations seriously (Butler & Daly, 2009; Hedwig et al., 2009; Molla, 2008; 2009). Jenkin, Webster, & McShane (2011) estimated that a large portion of the firm's electricity costs (and concomitant greenhouse gas emissions) is associated with IT energy use; e.g., 26% for office buildings, 95% for data centers. The manufacture and disposal of IT products have resulted in toxic hotspots (Jenkin et al., 2011).

Approximately 2% of the global electricity was consumed by the data centers worldwide (Meijer, 2010); about 3% of the global electricity usage was accounted for by information and communications technology (ICT) infrastructures that created an equivalent percentage of greenhouse gases (Ruth, 2009). Therefore, firms can garner significant cost savings by adopting energy-efficient technology; they also can benefit from proper disposals of technology parts and equipment through environment-friendly reuse and recycling, thereby reducing the toxins and carcinogens that, if emitted or disposed of freely, can lead to detrimental legal battles and social relationship nightmares (Chou & Chou, 2012; Meijer, 2010; Ruth, 2009; Velte, Velte, & Elsenpeter, 2008). In addition, green IT practices are socially desirable and ethically responsible, above and beyond economic viability and benefits (Ambec & Lanoie, 2008).

However, not many firms seem to embrace green practices enthusiastically. According to a recent survey by Fujitsu in 2011, the overall green IT maturity level is low in the U.S., U.K., Australia and India; the green index seems dismal, recorded at 56.4 on a scale of 100 in these countries, across different industries. Approximately 45% of the firms in the U.S. and 31.7% of the firms in India have appointed a designated person in charge of the firm's green IT initiatives.[5] Another survey reports similar figures: 32% of the firms made efforts to improve cooling efficiency, 17.5% incorporated power-down

[5] Survey details and key results are available at http://www.ictliteracy.info/rf.pdf/green_IT_global_benchmark.pdf, accessed in May 2012.

features on servers, and 7.7% implemented liquid cooling in data centers.[6] Green IT initiatives seem to be in the middle of the firm's priorities. For example, CompTIA's Annual Green IT and Insights study shows 9% of the responding firms rated green IT as an upper-half organizational priority in 2009; this figure reached 57% in 2011 (CompTIA, 2011) but still remains at a low level. Olson (2008) attributes the intriguing surprise of slow adoptions of green IT practices by firms to the relatively long pay-back period and argues that firms seem more motivated by nonfinancial benefits (such as corporate citizenships) than by direct economic gains. Melnyk, Sroufe, & Calantone (2003) suggest that the tangible, economic benefits that firms can realize in a short time horizon could in effect, have "discouraged" them from going green with IT. As Olson (2008) concludes, many firms seem to struggle with the "environmental, social issues" versus "top-line revenues and bottom-line costs" dilemma in their decision making.

Nevertheless, the significance of green IT practices is well recognized. Gartner (2010) identifies green IT as a top strategic technology; Costello (2011) also shows green IT and sustainability to be a critical technology and strategy trend. The resource-demanding IT industry could benefit from reuse and recycling throughout the technology life cycle (Ruth 2009). Despite the recognition and growing attention and emphasis that green IT practices attract, firms seem not to be practicing in the portrayed environment-friendly way (Gartner, 2007). Murugesan (2008) therefore issued a moving call by advocating firms to "green" their technology practices. As the global economy landscape

[6] Design details and important results of this survey are available at http://searchdatacenter.techtarget.com/originalContent/0,289142,sid80_gci1264212,00.html, accessed in July 2011.

shifts toward ecological sustainability, the contextual environments in which firms operate and compete likely will change, which is in part manifested by the increasing consumer awareness and preferences, emerging market opportunities, demanding industry self-restrictions, and established laws and governmental regulations (Shrivastava, 1995; Sheth, Sethia, & Srinivas, 2011). Green practices should play a much larger role in the technology selection, operations, and utilization by firms (Butler & Daly, 2009); according to Loeser, Erek, Schmidt, Zarnekow, & Kolbe (2011), "[s]ustainability has emerged as a relevant topic of strategic management during the last years – and it is supposed to become a game-changing megatrend" (p.1).

The intriguing gap between firms' awareness and actual practices is alarming, and therefore, warrants research attention. In this study, we address this research void by examining essential determinants of firms' green IT practices, anchored with established social and organizational theories, and testing their impacts empirically. Specifically, we propose a framework premised in institutional theory and social contracts theory, and then use this framework to develop a model for explaining firms' decisions on whether to practice green IT. We test our model with survey data obtained from 304 major firms in Taiwan. Overall, the data support our model and most of the associated hypotheses. According to our results, global environmental awareness, industry norms, and key stakeholders' attitudes have significant, direct influences on the firm's green IT practices. Although laws and government regulations seem to not be affecting firms' green IT practices directly, they insert important impacts through industry norms. Next, we review representative previous research to reveal the gaps that motivate our study.

Literature Review

Previous research has analyzed key motivators of firms' practicing green IT (Ambec & Lanoie, 2008; Jenkin et al., 2011; Lanoie; 2008; Marcus & Fremeth, 2009; McLaren, Manatsa, & Babin, 2010; Molla, 2009; Rao & Holt 2005; Siegel, 2009). Economic (financial) analysis seems to be a common perspective; several studies examine why firms do so, or should do so, economically? Ambec and Lanoie (2008) analyzes important economic benefits and reports that firms' environmental performance could lead to improved financial performance that exceeds the costs of going green. Siegel (2009) suggests that firms should implement green practices only if such practices complement their business strategy and contribute to firm profitability, ultimately. The moral aspect represents another prevailing emphasis. Marcus and Fremeth (2009) advise firms to take green initiatives because of their social and moral obligations toward sustainable developments. According to Murugesan (2008), "[g]reen IT strives to achieve economic viability and improved system performance and use, while abiding by our social and ethical responsibilities" (p.26). Although firms should consider green IT practices in terms of competitiveness, sustainability, and corporate social responsibility (Molla et al., 2009; McLaren et al., 2010), they may lack the capability necessary for practicing in ways that comply with the growing environmental preservation demands and social/moral responsibilities (Rao & Holt, 2005).

Previous research seems to focus on conceptual analyses of green practices in general (Bansal & Roth 2000; Bucholz, 1991; Suchman, 1995); theory-based, holistic analyses and empirical examinations of firms' green IT practices seem limited (Butler, 2011; Elliot, 2011; Jenkin et al., 2011; Melville, 2010; Molla et al., 2009; Watson,

Boudreau, & Chen, 2010). While a handful of studies have explored different issues concerning green practices, they tend to emphasize clean technology (González, 2005; Johnnston & Linton, 2000), green supply chain (Chien & Shih, 2007; Lee, 2008; Zhu, Saikis, & Lai, 2008), or a broad research agenda (Elliot, 2011; Jenkin et al., 2011; Melville, 2010; Watson et al., 2010).

When deciding on whether or not to practice green IT, firms likely will consider key factors of different dimensions. Elliot and Binney (2008) suggest firms assess environmental issues first, before incorporating the business drivers to seek for green IT solutions, implementing green practices, or estimating the results attainable with such practices. Firms should keep their key stakeholders in mind, such as customers and equity holders (Elliot & Binney, 2008; Watson et al., 2010) as well as major competitors (Ambec & Lanoie, 2008; Babiak & Trendafilova, 2011; Siegel, 2009). Customers are the only reason why a firm exists (Prandelli, Sawhney, & Verona, 2008); customers' attitudes and preferences must play an essential role in the firm's decision making (Watson et al., 2010). Equity holders have kernel interests in the firm's performance and valuation (Ambec & Lanoie, 2008), and usually have substantial influences on the firm's strategies and operational choices, directly or indirectly (Ambec & Lanoie, 2008; Siegel, 2009). In light of the competitive dynamics (Chen, Smith, & Grimm, 1992), a firm should take into account the competitors' strategies and practices when assessing whether or not to green its IT operations.

Our literature review suggests that firms may consider distinct but related factors when making green IT practice decisions. Most previous research is exploratory in nature, has limited theoretical foundations in the conceptual analysis or model

(hypothesis) development, tends to emphasize a particular aspect (such as economic), rather than providing a holistic depiction, and offers little empirical testing. We attempt to mitigate these gaps and provide a more holistic depiction of firms' green IT practice decisions by proposing a framework that has an appropriate theoretical foundation and considers important factors of different dimensions. Next, we describe our proposed framework, which in turn guides our model and hypothesis developments which can then be tested empirically.

Research Framework and Theoretical Foundation

As we show in Figure 4.1, our framework identifies and connects important factors at different levels, ranging from contextual environment, to industry, and then the firm. Our framework is hierarchical intrinsically and has its theoretical roots in institution theory and social contracts theory.

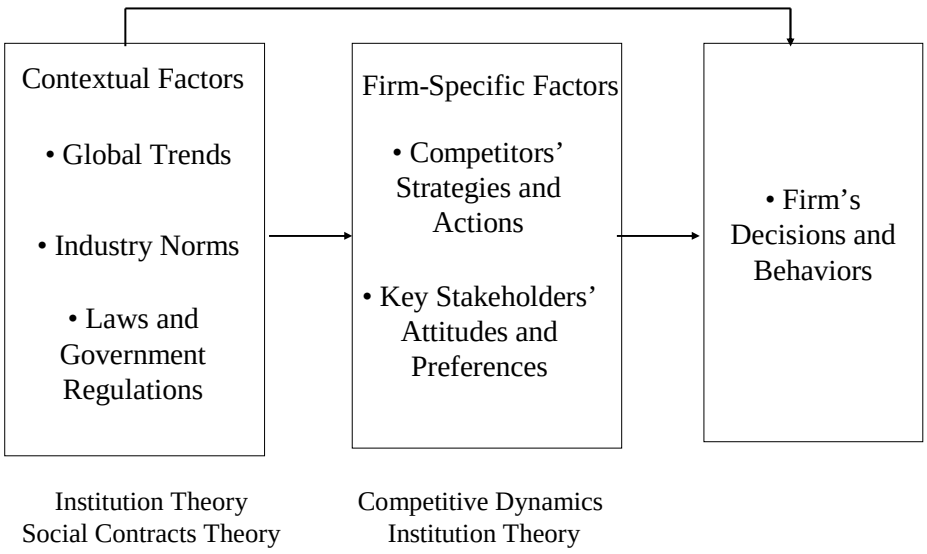

Figure 4.1. Research Framework of the Green IT Practice Study

A firm's green IT practice decision involves essential factors that pertain to socio-environmental context, laws and government regulations, industry norms, and market competition (Bansal & Roth, 2000; Siegel, 2009), which can be reasoned with institutional theory (Campbell, 2007). According to this theory, the environment not only provides resources and information for the firm's operations but also creates social pressures that impact its practices (Scott & Meyer, 1983; Scott, 1992). In the presence of such institutional pressures, firms likely will take actions isomorphic with the pressures to gain legitimacy, resources, and survival capabilities (DiMaggio & Powell, 1983).

In addition to revealing the importance of contextual factors, institutional theory also points to several specific forces that shape a firm's structure, rules, norms, routines, and behaviors (Scott, 2004) by positing that the firm's decisions are influenced by coercive, mimetic and normative pressures (DiMaggio & Powell, 1983). Coercive pressures are usually associated with powerful stakeholders upon whom a firm depends; mimetic pressure arises when a firm models other firms' behaviors in pursuit of legitimacy or taken-for-granted practices. Furthermore, a firm is often compelled to honor the expectations of professional circles or society as a whole, which thus, creates normative pressures (DiMaggio & Powell, 1983). Together, these institutional forces nourish and foster a set of values, norms and rules that promote desirable practices or structures among firms. As a result, firms in the same industry or a related industry are subject to similar underlying forces that emanate from them and make the institutional environments increasingly homogenized (Babiak & Trendafilova, 2011). As Babiak and Trendafilova (2011) as well as DiMaggio and Powell (1991) point out, the changes resulting from these institutional forces, often taking place through coercive, mimetic and

normative processes, can foster standardized, rationalized practices among firms within or even beyond the industry boundaries.

By conforming to institutional pressures, firms seek and maintain legitimacy; i.e., a generalized perception or assumption that the actions of an organization are desirable or appropriate with respect to the underlying socially constructed system of norms, values, beliefs, and definitions (Suchman, 1995). Legitimacy is indispensable to firms' long-term survivals (Bansal & Roth, 2000); therefore, firms are motivated to comply and avoid noncompliance sanctions. Through process of compliance and homogenization, firms are likely to adopt practices similar to those of the effective firms. Overall, institutional theory offers a lens for explaining how firms become homogeneous in light of social, moral, competitive pressures (Campbell, 2007); it underscores firms' abilities to influence one another regarding the practices consistent with institutional preferences.

While institutional theory describes how the environment exerts pressures on firms, social contracts theory (Donaldson, 1982; 1989) can explain how individual firms make decisions or choose reactions by focusing on firm-specific considerations. According to this theory, firms, like individuals, unite into a society through a process of mutual consent and thereby, agree to abide by a common set of rules, norms or principles, and accept duties to protect one another from violence, fraud, negligence; firms violating these institutional forces could face reduced legitimacy and eventual extinction (Brouthers, 2002). That is, firms form moral and social-political obligations on the basis of contracts and agreements, explicit or implicit, which underpin the environment in which they operate (Dunfee, Smith, & Ross, 1999). Donaldson (1982; 1989) analyzes corporate legitimacy in light of social contracts and argues that firms exist only through

the cooperation and commitment of society; thus, they must emphasize social-moral considerations. As Donaldson (1982) comments, “corporations considered as productive organizations exist to enhance the welfare of society through the satisfaction of consumer and worker interests, in a way which relies on exploiting corporations’ special advantages and minimizing disadvantages” (p. 54).

The social contracts theory provides a lens to scrutinize firms’ social responsibilities and thereby, connect firms and the society in which they operate via social contracts (Dunfee et al., 1999). The contract specifics and their impacts can be determined by a firm’s rational responses, with two common assumptions: The contractor (i.e., the firm) is aware of and concerned about bounded moral rationality; and the contractor, in the presence of bounded moral rationality, recognizes the need of a community-based moral fabric for creating wealth and maintaining an environment conducive to a good and productive life (Dunfee et al., 1999). At a macro level, firms, in principle, should act in the interest of the world, the social-governmental system, and the industry where they reside.

Donaldson and Dunfee (1994) extend social contracts theory and propose integrative social contracts theory, positing that business decisions should be made in light of their impacts on the firm’s community, ethical norms, and the concerned universal moral standards. This extended theory emphasizes the normative, hypothetical contracts of socioeconomic entities (e.g., firms) in the community (Donaldson & Dunfee, 1994). A normative, hypothetical contract among autonomous firms is a general, classical contract that provides guidance for firms’ decisions or behaviors, as it lays out normative ground rules for creating an implicit contract concerning essential parameters and issues among

firms as members of the community (Donaldson & Dunfee, 1994). Firms, thus, are likely to make decisions in congruence with normative, implicit contracts; in this light, an action or reaction could be viewed as ethical versus unethical, dependent on whether the underlying contracts are honored or breached. From the perspective of ethical decision-making, firms should seriously consider the consequences of their decisions and behaviors in relation to the encapsulating community, according to commonly accepted, universal moral principles (Dunfee, 2006).

The environment in which firms operate and compete spans across multiple levels that include global, sociopolitical, and industry; therefore, firms should make decisions or operation choices by considering key factors pertaining to each level. In general, the contractor (e.g., firms) of a macro contract is likely to adhere to the principles that allow existence of the micro contract for reducing the moral opaqueness that is created by the bounded rationality constraints (Donaldson & Dunfee, 1994). For example, a firm's decision or behavior can be simultaneously affected by global trends and the laws and regulations stipulated by government agencies endowed with the jurisdiction power. At the same time, firms, as members of the business community (e.g., industry), need to comply with normative, implicit contracts; thus, their operation choices are affected by such contracts that often are guided by the norms commonly accepted in the industry; i.e., industry norms. In effect, industry norms play an important role in social contracts, as they define the moral norms of business ethics and govern the socioeconomics among autonomous firms in the industry. As Donaldson and Dunfee (1994) point out, the contractor of a macro-social contract has to retain the freedom of specifying the norms at a finer-grained level; i.e., in the micro-social context. As a result, firms competing in a

highly competitive environment typically attempt to reduce uncertainty by complying with the global trends, as part of a macro contract, and, at the same time, are constrained by micro contracts, such as industry norms, laws and government regulations.

The social contracts theory in general and the integrative social contracts theory in particular reveal the relationship between firms and their business environment in business decision making and operational choices. Because of the bounded moral rationality, firms may have a tendency of following the global trends, industry norms and government regulations in their economic activities and business operations for efficiency improvement or uncertainty reduction (Donaldson & Dunfee, 1994).

A “free zone” (i.e., uncertainty in the environment) seems to exist outside the encapsulating macro contracts or micro contracts. To cope with environmental uncertainty, firms often consider their key stakeholders and competitors when making business decisions, congruent with the views of stakeholder theory (Freeman, 1984) and competitive dynamics (Chen et al., 1992). Such firm-specific considerations are essential for green IT practices. In particular, customers and equity holders (i.e., investors) are crucial stakeholders of a firm. Customer centrality has become the mantra of modern businesses; firms must place customers in the center of their decision making and operations (Prandelli et al., 2008). Investors own equity of the firm, they have direct interests in the firm’s performance and valuation and often can exercise substantial influences, directly or indirectly, on the firm’s strategic decisions and operations (Ambec & Lanoie, 2008; Siegel, 2009). Furthermore, according to the competitive dynamics analysis (Chen, Su, & Tsai, 2007), a firm’s decision involves the awareness of major competitors’ actions, responding with chosen motivations, and building the capability

necessary for the chosen reaction. This awareness-motivation-capability chain underscores the importance of competitors' actions in the firm's choice of competitive strategy and operations. Overall, our framework suggests the firm's green IT practices are affected by important factors pertaining to the contextual environment (i.e., global trends, laws and government regulations, industry norms) and firm-specific considerations (i.e., customers, equity holders, competitors). Building on this framework, we develop a model for firms' green IT practices, which we describe next.

Research Model and Hypotheses

Our model, shown in Figure 4.2, posits that a firm's green IT practice decision is affected by both socioenvironmental and firm-specific factors. According to integrative social contracts theory, firms' decisions and behaviors are governed by macro and micro contracts, normatively and implicitly. In this light, global trends, industry norms, and laws and government regulations are essential. A prominent trend is global environmental awareness; i.e., the global awareness of the environmental problems and shared consciousness of being responsible for future generations (Cohen 2010; Diekmann & Franzen, 1999). Such awareness represents a crucial social movement toward environmental conservation and thereby, creates pressures for firms' taking more social responsibility to protect the environment. Industry norms convey the commonly accepted actions and shared values among firms in an industry, in terms of environmental issues and social results of business strategies and operations toward fulfilling firms' environmental responsibilities (Stern, Dietz, & Black, 1985; Jenkins & Yakovleva, 2006; Norman & MacDonald, 2004). Firms, as members of an industry, have a tendency to

conform to the industry norms in order to maintain the industry homogeneity and ensure the profit pool of the whole industry. Furthermore, the laws and regulations stipulated by government agencies also can foster green operations and processes among firms by holding them legally responsible for environmental preservation and sustainability (Chien & Shih, 2007). According to Bansal and Roth (2000), social responsibility and legitimation represent two common motivations for firms to go green.

Firms also align their business decisions with key stakeholders' preferences and expectations, while observing and responding to competitors' actions. Key stakeholders' attitudes toward green practices are important and, in our study, refer to a firm's major stakeholders' predispositions of its consistent, reliable responses toward environmental sustainability (Rashid, 2009). Customers and equity holders (i.e., investors) represent two

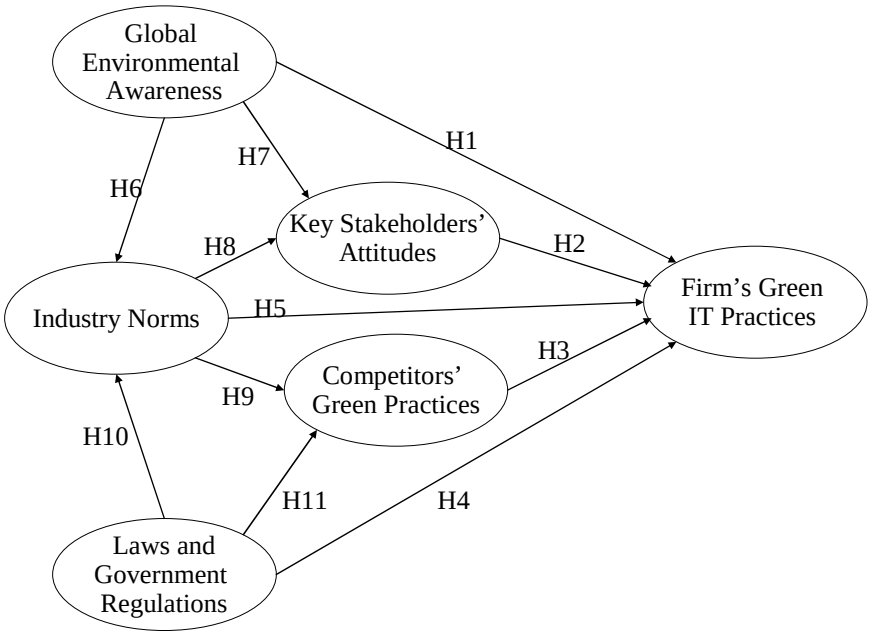

Figure 4.2. Research Model the Green IT Practice Study

critical stakeholders (Babiak & Trendafilova, 2011; Sarkis, Gonzalez-Torre, & Adenso-Diaz, 2010). Firm-customer relationships have great impacts on firm performance and long-term survival (Berman, Wicks, Kotha, & Jones, 1999). Equity holders invest in a firm and usually demand superb performance and sustainable, sufficient returns from the firm, while reducing uncertainty and downside risks (Ambec & Lanoie, 2008). Furthermore, competitors can affect the firm's strategies and behaviors as well. We consider competitors' green practices, which refer to a firm's perception of how much its competitors value and attempt environmental preservation by improving their internal operations and supply chain activities via recycling, reclamation, remanufacturing, or reverse logistics (Godfrey, 1998; Naffziger, Ahmed, & Montagno, 2003). Green practice initiatives taken by competitors can create substantial pressures for firms that, then, have to respond adequately for territorial interests and profitability (Chen et al., 1992). In the following, we develop each hypothesis suggested by our model.

To compete in a fast-changing market, firms must adapt to global trends by adjusting their priorities, strategies, or operations (Olson, 2008). The mounting global environmental awareness could force firms to consider environment-friendly practices seriously. Such awareness also encourages firms to explore alternative ways to conduct business for improved operations efficiency. An expanding array of green products and solutions enable firms to practice IT in a more energy-efficient way. Such practices not only conserve natural resources but also reduce operation costs. Furthermore, global environmental awareness can create institutional pressures for firms (Chen et al., 2009); the resulting pressures for environmental sustainability in turn, forces firms to green their IT in order to meet corporate social responsibility and moral obligations. Such pressures

can be explained with social contracts theory, which posits that firms achieve legitimacy by fulfilling corporate social responsibilities expected in implicit, macro-social contracts (Donaldson, 1982; 1989). By sensing the mounting global environmental awareness, firms are more likely to practice green IT than otherwise. Therefore, we hypothesize a positive association between global environmental awareness and firms' green IT practices:

H1: The global environmental awareness perceived by a firm is positively associated with its green IT practices.

Stakeholders are a "group or individual who can affect or is affected by the achievement of the organization's objectives" (Freemen, 1984, p. 46). Key stakeholders often play important roles in shaping the firm's values, strategies and operations; thus, firms must make business and operational decisions in alignment with their interests, expectations, and preferences (Siegel, 2009). According to stakeholder theory (Freeman, 1984), firms should manage the expectations of key stakeholders and comply with their attitudes, values or preferences for improved competitiveness and long-term performance (Gadenne, Kennedy, & McKeiver, 2009). Customers and equity holders are crucial stakeholders of the firm. Positive customer assessments of, and preferences toward a firm's operations, products, or services are central to firm performance (Berman et al., 1999; Waddock & Graves, 1997). Firms also need to consider equity holders' values and preferences in their decisions and operational choices (Ambec & Lanoie, 2008; Siegel, 2009). In turn, these stakeholders' attitudes could affect the firm's strategies and decision, in our case, key stakeholders could demand a firm fulfill its social responsibilities of environmental sustainability, in addition to providing competitive products and quality

services at low costs (Sarkis et al., 2010). In light of institutional theory, stakeholders can exert significant coercive pressures on firms. As Sarkis et al., (2010) points out, firms' being cohesive to their stakeholders' attitudes is crucial for establishing social legitimacy; that is, a firm's aptitude for green IT practices could be affected by its key stakeholders' attitudes, partly because of their coercive and normative pressures (Delmas & Toffel, 2004). We therefore hypothesize:

H2: A firm's key stakeholders' attitudes toward green practices are positively associated with its green IT practices.

Market competitions determine firms' performance, profits, and survival (Buckley, Pass, & Prescott, 1988); therefore, firms must pay close attention to major competitors' actions and respond in an effective and timely manner (Chen et al., 2007). According to the competitive dynamics analysis (Chen et al., 2007), monitoring competitors' strategies and actions is central to firms' strategic decisions. Thus, firms should adjust their attitudes and considerations when their major competitors take environment preservation initiatives; e.g., switching to energy-efficient operations. The influences created by competitors can be explained by institutional theory; in our context, competitors' green practices can exert cultural-cognitive, mimetic pressures on firms (Butler, 2011; Campbell, 2007) that have a tendency of reducing uncertainty and thus, are motivated for ecological responsiveness (Bansal & Roth, 2000). That is, the competitive forces shaped by competitors' green practice could lead to firm's mimicry or taking strategic changes (Delmas & Toffel, 2004); the resulting mimetic pressures can be manifested by firms' adopting environmental standards, or disclosing and launching sustainability initiatives (Jennings & Zandbergen, 1995; Reid & Toffel, 2009). Accordingly, we posit a positive

association between major competitors' green practices and a firm's green IT practices and thus, test the following:

H3: Competitors' green practices as perceived by a firm are positively associated with its green IT practices.

Laws and government regulations create legal forces affecting firms' decisions and behaviors (Sarkis et al., 2010). Firms can reduce liability risks or avoid costly litigations by complying with the concerned laws and government regulations, which in turn can encourage green practices by firms (Ambec & Lanoie, 2008). Legitimation can provide an important motivation for firms' competitive actions (Bansal & Roth, 2000; Molla, 2008), because firms have motives of making operational choices in line with the established laws and regulations (Suchman, 1995). Thus, legislative imperatives and regulatory requirements can play a significant role in the firm's decision on whether to green its IT practice, even in the absence of tangible economic benefits (Molla, 2008). Many governments also establish legal and regulatory frameworks that provide tax incentives to firms that satisfactorily comply with the recommended standards or practices; e.g., reducing energy-consumption, hazardous waste disposals or emissions. Therefore, government agencies can foster a green economy by demanding firms to become greener, with nontrivial tax incentives. We accordingly hypothesize the following:

H4: Laws and government regulations are positively associated with a firm's green IT practices.

Despite the absence of legal enforcement power, industry norms could create normative pressures of legitimation for firms (Butler, 2011). To establish a desirable

legitimacy, firms observe their peers and conform to the norms and practices commonly accepted in the industry. In light of the institutional pressures in general and the normative pressure in particular (Avellaneda, 2009; Bansal & Roth, 2000), deviations from the industry norms could be costly to firms. In turn, the resulting normative pressures encourage firms to adopt green IT practices, so as to comply with the industry-wide movement toward sustainability. Hoffman (1999) shows that industry associations play an important role in setting industry norms for environmental conducts that protect the industry's collective reputation. In addition, industry norms also represent implicit social contracts to firms that, as members of an industry, should comply with such industry-level contracts; i.e., commonly accepted norms in the industry. With industry norms firmly established, firms have stronger conformity motivations than they otherwise might (Miller & Chen, 1996). Conformity is central to the diffusion of the industry norms by firms and can affect firms' decisions and practices significantly (Miller & Chen, 1996). Therefore, we hypothesize a positive association between the industry norms regarding environmental sustainability and a firm's green IT practices:

H5: The industry norms regarding environmental sustainability perceived by a firm is positively associated with its green IT practices.

Industry norms characterize the commonly accepted values in the industry and thereby, reflect the changes and impacts in the broader, contextual business environment (Corbett & Kirsch, 2001). The growing concerns over environmental sustainability disseminate in the global networks of production, supply chain, logistics and marketing, and thereby, foster environment-friendly practices that shape the shared value and practices in the industry (Corbett & Kirsch, 2001) and then create normative forces on

firms (Butler, 2011). The increasing global awareness of environmental protection also leads to the creation of shared values among firms in an industry. That is, such awareness promotes the value of conserving environmental resources, which, if widely adopted and deeply penetrated in an industry, lead to the creation of industry norms. From a multi-level view, global environmental awareness represents a higher-level social contract and industry norms correspond to lower-level social contracts. A macro contract offers the overarching principles that need to be incorporated in the micro contracts underneath it (Donaldson & Dunfee, 1994); in this light, we anticipate industry norms to conform with the global environmental awareness of environmental sustainability and thus, test the following hypothesis:

H6: The global environmental awareness perceived by a firm is positively associated with the industry norms regarding environmental sustainability.

Global environmental awareness could affect all the entities in society, including the firm's stakeholders (Gadenne et al., 2009). As customers become increasingly knowledgeable and concerned about environmental issues, their attitudes will favor green products and operations that in turn influence firms' decisions and behaviors (Bohlen, Schlegelmilch, & Diamantopoulos, 1993; Butler, 2011). Equity holders normally demand satisfactory performance and a positive corporate image from the firm in which they invest (Freemen, 1984). Because of fast-growing media coverage of issues concerning environmental sustainability, equity holders could pay more attention to the impacts of the firm's operations on the environment, and their attitudes could affect the firm's operational choices; e.g., assuming more green responsibilities (Gadenne et al., 2009). Key stakeholders' attitudes can be affected by general awareness and public consensus

and could impact firms' strategies and operations directly (Freeman, 1984; Sarkis et al., 2010). With the rising awareness of environmental sustainability, we expect stakeholders to be mindful about the firm's decisions and operations. As Gadenne et al., (2009) comments, global environmental awareness has important implications to a firm's strategy and operational choices, including the associated costs and benefits, which concern its key stakeholders. Thus, we hypothesize a positive association between global environmental awareness and the firm's key stakeholders' attitudes toward green IT practices and test the following accordingly:

H7: The global environmental awareness perceived by a firm is positively associated with its key stakeholders' attitudes toward green practices.

The firm's stakeholders, individuals or organizations alike, observe important trends and changes in the market as well, form or adapt their beliefs and values accordingly, and then choose the position they wish to hold on ideological, normative, financial, or other grounds (Lempert & Schlesinger, 2000). Stakeholders have expectations of the firm that can be considered as a function of their perceptions of behavioral norms in light of an appropriate referent group (Logsdon & Yuthas, 1997). Because key stakeholders have substantial, vested interests in the firms' performance and long-term competitiveness, they are likely to pay attention to the preferred practices or commonly accepted norms in the industry, and adjust their expectations accordingly. As Logsdon and Yuthas (1997) point out, stakeholders make frequent comparisons among firms within the industry. For example, customers would expect a firm to follow the industry norms for ensuring its products and services conform to the industry standards. To ensure a firm does not deviate from the industry's shared value, and thereby maintain a positive image

(Freemen, 1984), equity holders also expect the firm to follow the industry norms. Furthermore, equity holders and customers are central to the firm's value chain that should be guided by the industry norms. Therefore, we postulate a positive association between the industry norms as perceived by a firm and its key stakeholders' attitudes toward green practices:

H8: The industry norms regarding environmental sustainability perceived by a firm is positively associated with its key stakeholders' attitudes toward green practices.

Industry norms can influence a firm as well as its competitors. Firms in the industry compete against one another by offering alternative products and services, contending for finite resources, and seeking similar, desirable market positions (Porac & Thomas, 1990). Firms in direct competition usually operate in the same organization field of suppliers, resources, customers, and regulations. According to institutional theory, firms facing the same organization field would become homogeneous over time, because they are imposed upon by the same intuitional pressures that include the industry norms (DiMaggio & Powell, 1983). From the lens of social contracts, firms in an industry consent to the same industry-level social contracts; i.e., industry norms. Industry norms that value environmental sustainability therefore, could help the firm and its competitors better recognize the value of green practices. In turn, such shared value and recommended practices, conveyed by the industry norms, could encourage firms to compete in the dimension of green practice (Molla, 2008; Porter & Kramer, 2006). Therefore, we hypothesize a positive association between the industry norms regarding environmental sustainability and competitors' green practices as perceived by a firm:

H9: The industry norms regarding environmental sustainability perceived by a firm is positively associated with its competitors' green practices.

The institutional theory suggests the importance of both formal and informal forces that shape a firm's strategies and actions (DiMaggio & Powell, 1983). Such forces are distinct but not mutually exclusive; rather, the formal forces can reinforce the informal ones (Bansal & Roth, 2000; Suchman, 1995). Prior research shows laws and government policies/regulations to be effective interventions of industry norms (Gunningham & Rees, 1997); they can guide the goal setting and schema selection by firms that then shape industry norms and their dissemination among firms (Molla, 2008; Siegel, 2009). By setting laws and regulations that involve taxation or environmental permits, government agencies can promote environment-friendly practices by firms and seed industry self-regulations (Gunningham & Rees, 1997). All else being equal, well-thought, widely accepted industry norms are more likely to emerge in the presence of laws and government regulations than otherwise (Campbell, 2007). The fundamental rationale of government intervention, in the form of laws and regulations, is to alleviate market failure and address potential social costs or negative network externalities (Siegel, 2009). In an industry, firms are motivated to comply with government regulations in order to ensure the long-term success of the industry as a whole. This reasoning suggests government regulations influence the industry norms regarding environmental sustainability (Molla, 2008); accordingly, we test the following:

H10: Laws and government regulations are positively associated with the industry norms regarding environmental sustainability as perceived by a firm.

All firms have a desire to maintain competitive edges by complying with the concerned laws and government regulations. According to the competitive dynamics analysis by Chen et al., (1992), laws and government regulations create external changes to firms and demand proper actions (reactions) from them. In our context, a firm and its competitors choose green IT practices to defend and improve their competitive positions in accordance with the laws and regulations enforced by governments (Derfus, Maggitti, Grimm, & Smith, 2008). From a contract aspect, laws and regulations are formal social contracts that firms must comply with; thus, a firm's competitors can face substantial legal risks if failing to meet the concerned laws and regulatory requirements. To mitigate legal risks and avoid costly litigations, competing firms are likely striving to comply with laws and regulations and thereby, maintain legitimation. Accordingly, we test the following hypothesis:

H11: Laws and government regulations are positively associated with the green practices of a firm's competitors.

Study Design and Data

We conducted a survey study to test our model and the hypotheses it suggests. In this section, we detail our study design, including targeted firms and measurements, and describe our data collection.

Targeted firms. We targeted major Taiwanese firms in manufacturing and service sectors. Our firm choices were made primarily on the basis of their importance and ripple effects of fostering green IT practices in their industries. To identify the prospective firms, we used a directory that lists all the firms in Taiwan, which also summarizes their

main business lines and contact information. We chose the largest 2,000 firms and took a key-informant approach by targeting the chief information officer (or chief technology officer) who normally plays a central role in IT-related decisions and has a good understanding of the firm's overall business operations. These senior executives are appropriate for providing evaluative responses concerning their firms' considerations, assessments, and decisions about green IT practices.

Measurements. We used previously validated scales to measure the constructs in our model. Specifically, we operationalized industry norms with items adapted from Babiak and Trendafilova (2011), and Stern et al., (1985); we measured laws and regulations with items from Chien and Shih (2007). Items for measuring key stakeholders' attitudes were obtained from Mostafa (2007); items for competitors' green practices were from Zhu and Sarkis (2004). We used items developed by Hedwig et al., (2009) and Molla et al., (2009) to measure firms' green IT practices, our dependent variable. Global environmental awareness was measured with items that we developed on the basis of the conceptual analyses by Babiak and Trendafilova (2011), Cohen (2010), and Franzen (2003). We made a handful of minor wording changes to the adapted items for a better fit with our context and targeted informants. Each construct was measured by multiple question items, which all employed a seven-point Likert scale, with 1 being "strongly disagree" and 7 being "strongly agree." We list all the items used in our study in Appendix D.

We conducted the survey in Chinese, the official language in Taiwan. As all the question items were originally available in English, we employed the translation and back translation method (Brislin, Lonner, & Throndike, 1973). Specifically, we had the items translated into Chinese by two experienced, professional translators; the translated items

were then reviewed by three seasoned researchers, fluent in both English and Chinese (and not involved in this study), to ensure consistent semantics of each question item between languages. The items were then translated back to English by two (different) professional translators, and then reviewed by the same panel of researchers, who explicitly indicated satisfactory consistency of the items between English and Chinese.

Data collection. We employed a prestigious, professional survey company to administer the survey with the targeted firms we had identified. A team of properly trained telephone surveyors called each firm for voluntary participation. After obtaining an explicit agreement, a surveyor then conducted the survey with the firm's chief information officer (or chief technology officer) via phone. Before the survey, the surveyor used a prepared script to describe the study's purpose, stated the intended data analyses performed at aggregate levels, answered questions concerning privacy or confidentiality in accordance with several specified guidelines, and obtained the respondent's explicit agreement to participate in the study. The survey questions were presented verbally, one at a time; the surveyor allowed sufficient time for response. During the survey, a respondent could request for clarifications or elect to discontinue with the survey any time during the survey. With a verbal consent from each participant, all the responses were audio-recorded and subsequently transcribed to create the data for our analyses. Among the 1,261 firms that answered the calls by the survey company, 304 firms agreed to voluntarily participate and completed the survey, showing an effective response rate of 24.11%. Seven firms agreed to participate but could not complete the survey for various reasons. On average, the survey took 20 minutes to complete.

Data Analyses and Results

Among the participating firms, the distribution between manufacturing and service seemed to be balanced (see Table 4.1); approximately 55% of them were from manufacturing, particularly in electronics (18.09%), computers (7.24%), and non-metallic production (7.24%). Among participating service firms, many were in information and communication services (10.20%), followed by integrated circuitry design (8.22%), and then publication and media (5.92%). Our sample firms recorded significant annual sales figures and employed a large number of full-time employees; approximately 40% of them had annual sales exceeding 120 million U.S. dollars and, on average, employed more than 670 full-time employees.

The industry composition of our sample was similar to that of the overall company pool we targeted; i.e., largest 2,000 firms in Taiwan. In addition, the participating firms were representative of the entire targeted firms in terms of annual sales, firm size (measured by the number of full-time employees), and the number of years in continuous operations. Our between-groups analysis between the participating and non-participating firms showed no significant differences in annual sales, firm size, or the number of years in continuous operations, as suggested by a p-value > 0.05. Thus, our sample was representative of the firms in Taiwan we targeted. Because of the intent to examine firms' green IT practice across different industries, we therefore included industry as a control variable in our analyses.

Re-examining instrument validity. We examined our instrument's construct reliability in terms of reliability, convergent and discriminant validity, and composite

Table 4.1. Some Demographic Characteristics of Participating Firms

Characteristics		Number of Firms	Percentage of Firms
Industry category			
Manufacturing	Electronics	55	18.09%
	Computer	22	7.24%
	Non-metallic product	22	7.24%
	Chemistry	18	5.92%
	Metal & machinery	16	5.26%
	Communications	11	3.62%
	Motor vehicles and parts	6	1.97%
	Others	14	4.61%
Service	Information & communication service	31	10.20%
	Integrated circuit design	25	8.22%
	Publication and media	18	5.92%
	Finance & investment	16	5.26%
	Real estate	11	3.62%
	Trade, wholesale and retail	10	3.29%
	Transportation and logistic	7	2.30%
	Insurance	6	1.97%
	Others	16	5.26%
Annual Sales (in US dollar)			
Less than or equal to15 million		31	10.20%
15 million ~ 30 million		37	12.17%
30 million ~ 60 million		66	21.71%
60 million ~ 120 million		50	16.45%
120 million ~ 250 million		49	16.12%
250 million ~ 500 million		39	12.83%
500 million ~ 1 billion		24	7.89%
More than 1 billon		8	2.63%
Number of full-time employees			
Less than or equal to 100		66	21.71%
101 ~ 300		100	32.89%
301 ~ 500		41	13.49%
501 ~ 1000		45	14.80%
1001 ~ 3000		40	13.16%
More then 3000		12	3.95%

construct reliability. We evaluated internal consistency in terms of Cronbach's alpha and noted that all investigated constructs showed satisfactory reliability. As we summarize in Table 4.2, the composite reliability of each construct was greater than 0.7, a common threshold that signifies satisfactory construct reliability (Fornell & Larcker, 1981). We also examined the loading of each item on its corresponding construct. In general, items with a loading greater than 0.7 are considered reliable, whereas those with a loading lower than 0.5 should be considered for removal (Nunnally, 1978). Judged by this common threshold, our instrument exhibited adequate reliability as all item loadings exceeded 0.7 and were statistically significant at the 0.001 level.

We then examined convergent validity by evaluating the average variance extracted (AVE), which denotes the variance captured by an indicator (Fornell & Larcker, 1981). By and large, an AVE that exceeds 0.5 suggests adequate convergent validity (Fornell & Larcker, 1981).

Table 4.2. Summary of Reliability and Variance Extracted

	Mean	Standard Deviation	Cronbach's Alpha	Composite Reliability	Average Variance Extracted
Global environmental awareness (GA)	6.05	0.71	0.78	0.86	0.61
Industry norms (IN)	5.62	0.85	0.77	0.85	0.59
Laws and government regulations (LR)	5.75	0.92	0.85	0.90	0.69
Stakeholders' attitudes (SA)	5.40	1.03	0.77	0.87	0.69
Competitors' green practice (CG)	4.89	1.12	0.84	0.90	0.76
Firm's green IT practice (GIT)	5.50	0.85	0.72	0.83	0.55

As we show in Table 4.2, each investigated construct had an AVE score greater than 0.5, thus suggesting that our instrument exhibited adequate convergent validity. We further examined convergent and discriminant validity with the cross-loadings computed from the correlation between each construct's component score and the manifest indicators of other constructs (Chin, 2010). As we show in Table 4.3, all items loaded substantially higher on their own construct than on other constructs.

We also analyze the square roots of the AVEs in relation to the correlation among any pair of the latent constructs we studied. As we summarize in Table 4.4, the square roots of the AVEs were also greater than the correlation among any pair of latent

Table 4.3. Summary of Cross Factor Loadings of the Green IT Practice Study

	GA	IN	LR	SA	CG	GIT
GA-1	**0.83**	0.28	0.24	0.26	0.22	0.21
GA-2	**0.82**	0.34	0.29	0.27	0.23	0.31
GA-3	**0.80**	0.31	0.37	0.28	0.28	0.24
GA-4	**0.66**	0.29	0.23	0.31	0.27	0.27
IN-1	0.32	**0.76**	0.32	0.53	0.42	0.32
IN-2	0.32	**0.82**	0.26	0.48	0.42	0.41
IN-3	0.21	**0.76**	0.37	0.52	0.50	0.43
IN-4	0.36	**0.73**	0.33	0.57	0.41	0.40
LR-1	0.23	0.33	**0.80**	0.25	0.26	0.12
LR-2	0.30	0.39	**0.85**	0.32	0.29	0.23
LR-3	0.32	0.30	**0.86**	0.26	0.39	0.22
LR-4	0.34	0.37	**0.80**	0.32	0.35	0.16
SA-1	0.33	0.57	0.27	**0.85**	0.52	0.48
SA-2	0.26	0.51	0.23	**0.81**	0.50	0.47
SA-3	0.30	0.63	0.37	**0.82**	0.51	0.42
CG-1	0.34	0.56	0.35	0.58	**0.86**	0.44
CG-2	0.24	0.49	0.36	0.55	**0.88**	0.33
CG-3	0.26	0.42	0.31	0.47	**0.87**	0.34
GIT-1	0.18	0.34	0.14	0.36	0.25	**0.67**
GIT-2	0.28	0.29	0.19	0.33	0.27	**0.64**
GIT-3	0.28	0.39	0.20	0.47	0.35	**0.84**
GIT-4	0.26	0.46	0.15	0.45	0.38	**0.79**

Table 4.4. Latent Variable Correlations

	1	2	3	4	5	6
1. Global environmental awareness	**0.78**					
2. Industry norms	0.39	**0.74**				
3. Laws and government regulations	0.36	0.42	**0.77**			
4. Stakeholders' attitudes	0.36	0.69	0.35	**0.83**		
5. Competitors' green practice	0.32	0.57	0.39	0.62	**0.83**	
6. Green IT Practice	0.34	0.51	0.23	0.55	0.43	**0.87**

Note: Diagonal shows square root of Average Variance Extracted

constructs (Chin, 2010). Together, our results suggest the instrument possessing appropriate convergent and discriminant validity.

Common method bias. We used multiple methods to assess potential common method bias. First, we performed Harman's single-factor test (Podsakoff & Organ, 1986), which uses an exploratory factor analysis to determine if all items load on a single factor; if so, common method bias becomes a serious threat. According to our analysis results, the items in our data set loaded on six factors and therefore, suggested that common method bias does not represent a serious problem. Second, we further examined common method bias by using the smallest positive correlation among items as a conservative estimate (Lindell & Whitney 2001). In our data, LR-04 and GIT-01 indicated the smallest positive correlation, equal to 0.057. Following a suggestion by Lindell and Whitney (2001), we performed Fisher's *r*-to-*z* transformation on the correlation as follows:

$$z_r = \frac{1}{2}\ln\frac{1+r}{1-r} = \frac{1}{2}\ln\frac{1+0.057}{1-0.057} = 0.057 ,$$

and then computed the 95% confidence interval as

$$z_r \pm z_{1-\alpha/2}/\sqrt{N-3} = 0.006 \pm 1.96/\sqrt{304-3} = 0.057 \pm 0.1130 .$$

Common method bias is not significant statistically, because the confidence interval includes 0.

Model and Hypothesis Testing Results. We tested our model and hypotheses using partial least squares (PLS), which allows for simultaneous analyses of the measurement and structural models. PLS supports factor analysis with linear regressions and requires less stringent data distribution properties, such as multivariate normality (Gefen, Straub, & Boudreau, 2000). Furthermore, PLS allows simultaneous analyses of a large number of indicator variables and can support empirical testing of extensive interactions among moderator and latent predictors. We evaluated the explanatory power of our model by examining the R-square value of each non-endogenous variable. As we show in Figure 4.3, our model accounts for a significant portion of the variances in the firm's green IT practices (R^2 = 35%) and key stakeholders' attitudes (R^2 = 49%), and provides appropriate explanatory power for industry norms (R^2 = 24%), and competitors' green practices (R^2 = 35%). We tested each hypothesis by examining its statistical significance and effect magnitude manifested by the corresponding path coefficient. For increased robustness and statistical validity, we employed a bootstrap resampling procedure with resamples of 1,000 (Chin, 2010).

Our data supported most of the hypotheses we tested. According to our results, global environmental awareness exhibited significant, direct impacts on firms' green IT practices; path coefficient = 0.13, $p < 0.05$; so did key stakeholders' attitudes (path coefficient = 0.32, $p < 0.01$) and industry norms (path coefficient = 0.21, $p < 0.01$); therefore, our data supported H1, H2 and H5. However, the direct effects of neither

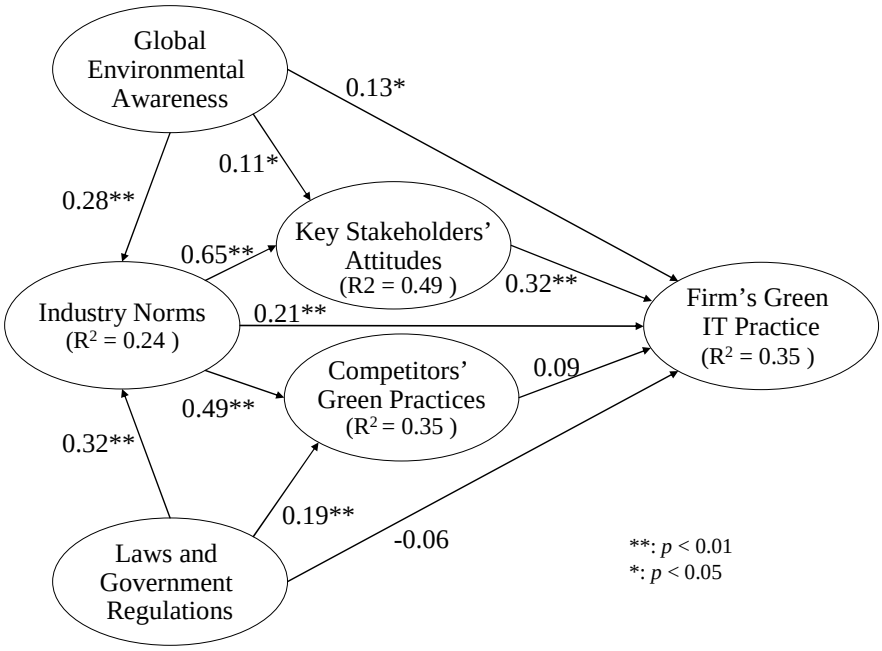

Figure 4.3. Model Testing Results

competitors' green practices nor laws and government regulations were significant statistically; i.e., our data did not support H3 and H4. Global environmental awareness had significant influences on industry norms (path coefficient = 0.28, p < 0.01) as well as on key stakeholders' attitudes (path coefficient = 0.11, p <0.05); i.e., our data supported H6 and H7. In addition, industry norms exhibited significant influences key stakeholders' attitudes (path coefficient = 0.65, p < 0.01) and competitors' green practices (path coefficient = 0.49, p < 0.01), in support of H8 and H9. Laws and government regulations significantly affected industry norms (path coefficient = 0.32, p < 0.01) and competitors' green practices (path coefficient = 0.19, p < 0.01); that is, our data supported H10 and H11. We summarize our hypothesis testing results in Table 4.5.

Table 4.5. Summary of Hypothesis Testing Results of the Green IT Practice Study

Hypothesis	Results
H1: The global environmental awareness perceived by a firm is positively associated with its green IT practices.	Supported
H2: A firm's key stakeholders' attitudes toward green practices are positively associated with its green IT practices	Supported
H3: Competitors' green practices perceived by a firm are positively associated with its green IT practices.	Not supported
H4: Laws and government regulations are positively associated with a firm's green IT practices.	Not supported
H5: The industry norms regarding environmental sustainability perceived by a firm is positively associated with its green IT practices.	Supported
H6: The global environmental awareness perceived by a firm is positively associated with the industry norms regarding environmental sustainability.	Supported
H7: The global environmental awareness perceived by a firm is positively associated with its key stakeholders' attitudes toward green practices.	Supported
H8: The industry norms regarding environmental sustainability perceived by a firm is positively associated with its key stakeholders' attitudes toward green practices.	Supported
H9: The industry norms regarding environmental sustainability perceived by a firm is positively associated with its competitors' green practices.	Supported
H10: Laws and government regulations are positively associated with the industry norms regarding environmental sustainability as perceived by a firm.	Supported
H11: Laws and government regulations are positively associated with the green practices of a firm's competitors.	Supported

Overall, our results suggest key stakeholder's attitudes are the most important, direct determinant of a firm's green IT practices; both global environmental awareness and industry norms are also significant and seem to have comparable total effects. Neither competitors' green practices nor laws and government regulations have significant, direct effects on firms' green IT; these results are consistent with the stakeholder theory that emphasizes the importance of key stakeholders' expectations and their coercive pressures on firms' strategic decisions (Gadenne et al., 2009). Although their direct effects seem insignificant, laws and government regulations can influence a firm's green IT practices indirectly, through their influences on industry norms. Nevertheless, this result may be

partly due to the relatively early developmental stage of green IT practices, and firms could be more motivated by competitiveness and legal forces when green practices become increasingly mature and the laws that protect environmental sustainability are further developed. In summary, the importance of laws and government regulations should not be underestimated; after all, they still could impact firms' green IT practices through the mediation of industry norms.

Competitors' green practices seem to have weak, insignificant effects. One probable explanation is that observing competitors' green practices could be difficult; thus, the pressure of mimicking competitors' green practices may become less strong or significant. The influences of competitors' behaviors, to some degree, may also be captured by the industry norms. As competitors operate in the same environment, their green IT practices can be perceived as part of the industry norms. The likelihood of making inferences of industry norms as a proxy of competitors' behaviors may increase when the competitors' practices cannot be observed directly and easily. Furthermore, the relatively small pressures of competitors could also be explained in terms of the early developmental stage; as a result, firms may not perceive many competitors to have embraced green practices, and therefore, the pressure is relatively weak.

Discussion

Our findings offer several implications for research. First, our results suggest separate examinations of the influences of different institutional forces, which can provide a better understanding of firms' reactions to institutional pressures created by distinct, contextual factors. We note significant, direct impacts of global environmental

awareness, industry norms and key stakeholders' attitudes; this underscores the importance of normative and coercive factors in firms' green IT practice decisions. According to our findings, the mimetic forces seem to have less influence on firms' green IT practices. While other factors might produce similar pressures, competitors represent an important source of mimetic pressures but their effects seem insignificant, statistically. In contrast to several previous studies suggesting the combined use of the three institutional forces to explain firms' strategic actions, primarily because they cannot be distinguished easily, our results reveal distinct impacts of each force. In the context of green practices, our findings further reveal the important roles of several motivators of firms' greening their IT practices. By further scrutinizing the important sources of different institutional pressures, we can provide a fuller depiction of the underlying influencing processes that affect firms' decisions.

Second, our study shows implicit, moral social contracts, such as global environmental awareness and industry norms, may have greater impacts on firms' green IT practice decisions than do explicit contracts, such as laws and government regulations. This result implies that many firms may consider green IT practices more from a social, moral perspective than from a legal aspect. Despite the need of avoiding legal risks, firms could consider the compliance benefits and costs associated with explicit social contracts relatively short-term. On the other hand, by fulfilling the moral social contracts, firms could improve their relationships with customers as well as the society in which they operate, thereby, advancing the corporate values and image for longer-term advantages (Babiak & Trendafilova, 2011). Green IT practices are generally viewed as a moral issue; this signifies a plausible public-goods orientation that makes firms approach decision

making and operational choices from a moral perspective (Chen et al., 2009). The described moral orientation can help a firm better assess the consequences for itself (e.g., benefit vs. cost impacts) and others (e.g., impacts on the overall environment and future generations). Toward that end, our results further underscore the important roles of industry norms and key stakeholders' attitudes in channeling the influences of global environmental awareness, or laws and government regulations. For example, industry norms denote the values a firm shares with others in the industry; key stakeholders' attitudes highlight the firm's motivation to assign its decisions and operations with the stakeholders' values and preferences. Such value sharing and assignment characterize the firm's compliance to the micro-level social contracts for legitimacy.

Third, our results reveal an influence cascading pattern from broader, contextual factors (e.g., global environmental awareness, laws and government regulations) to industry-level factors (e.g., industry norms), then firm-specific considerations (e.g., key stakeholders' attitudes, competitors' green practices), and ultimately the firm's green IT practice decision. Previous research has examined firms' green practices by anchoring them with institutional theory and considered firms in an industry to be homogeneous. Firms in an industry face similar competitive dynamics but may not react to an important environmental issue in an identical way. By considering firm-specific factors, such as key stakeholders' attitudes and competitors' green practices, we could produce more insights into the firm's decision making. Our findings are in concert with social contracts theory, suggesting that micro contracts are bounded by macro contracts, and that they jointly affect the firm's reactions to the growing trend toward environmental sustainability. However, the macro or the micro contracts alone cannot fully depict how firms should

behave in a competitive environment; firms have to choose strategies appropriate for their specific conditions, though their strategic decisions are all subject to the influences of the social contracts. Thus, our results suggest the existence of a free space that is not governed by social contracts; in this light, firms likely will self-regulate themselves in a manner congruent with social contracts and usually show a strong binding beyond what formal contracts specify. Furthermore, our results also suggest a mediating role of industry norms between macro contextual factors and firm-specific considerations. According to our findings, industry norms also serve as an essential conduit that channels the impacts of laws and government regulations on firms' green IT practices. Thus, the importance of industry norms cannot be overlooked; their impacts on the firm's green IT practices seems mediated by its competitors' green practices.

Our findings also have several implications for policy and practice. For example, government agencies can help firms become more aware of the global trend of going green by working closely with industry-specific societies and professional associations that are essential for seeding and pollinating the "green values" and developing industry norms regarding environmental sustainability. According to our results, global environmental awareness and industry norms represent two crucial, direct drivers of firms' green practices. Governments can promote desirable green with laws and regulations that can create desirable influences on firms' practices, via industry norms. When establishing laws and regulations, government agencies should work closely with entities that plan critical roles in defining and fostering industry norms. In addition, the significant, direct impacts of key stakeholders' attitudes suggest that customers and equity holders can insert substantial pressures on firms' green IT practices; toward that

end, government agencies could further advance the general public's awareness and knowledge about environmental preservation in the process of establishing laws and regulations.

Conclusion

Our study makes several contributions to green IT research. First, we augment the existing literature by proposing a framework, premised in institution theory and social contracts theory, which considers important factors at different levels and therefore, can provide a more holistic depiction of firms' green IT practices. Our framework explains how distinct institutional forces, individually and jointly, influence firms' decisions; i.e., coercive, mimetic, normative pressures. Most previous research describes and analyzes such institutional pressures at a conceptual level, without clear delineations between them (Chen et al., 2009); e.g., viewing the influences of industry norms as a mix of different institutional pressures (Chen et al., 2009). In contrary, we scrutinize important sources of each institutional force and show their distinct effects empirically. In addition, our study reveals a probable mediating process of institutional pressures, which further suggest the value and appropriateness of examining firms' green IT practices by differentiating these forces. Second, we anchor with social contracts theory, which suggests macro-level social contracts (e.g., global environmental awareness, laws and government regulations) can impact micro-level social contracts (e.g., industry norms). We show that a free zone may exist but is not governed by social contacts; i.e., important firm-specific factors not defined by social contracts but influenced by them. The proposed framework is general

and can be applied to analyze firms' other strategy choices and behaviors in response to key changes in the market.

Second, we also contribute to extant literature by proposing and empirically testing a model that explains firms' green IT practices. Our model is a nomological network, derived from a theory-based framework. While previous research has analyzed important benefits or motivators of green practices in general, how firms go about deciding on green IT practices remains unaddressed. Although several studies analyze green IT practices conceptually, they are limited in offering holistic depiction and offer little empirical testing. We address these gaps by examining firms' green IT practices by surveying 304 major firms in Taiwan. According to our empirical results, the model is capable of explaining firms' decisions adequately. The institutional perspective seems to offer a viable lens to investigate firms' green IT practices and future research is needed to further analyze and test essential contextual factors of different levels.

This study has several limitations that in turn point to future research directions. First, we analyze observable environmental drivers of green IT practices by examining different sources of pressures in their institutional environment; however, we do not measure firms' perceptions of such pressures. To further confirm the relationships postulated by crucial institutional forces, future investigations need to include valid, reliable measures of institutional pressure and empirically examine the relationships between essential environmental drivers and the pressures firms perceive. Second, our results are derived from a single study that examines a sample of firms participating in the study voluntarily; we therefore, cannot rule out potential self-selection biases. To address this limitation and produce more robust results, further studies are required,

particularly those adopting a comparative analysis design to examine firms across different industries or countries. Future research should also consider cultural differences as well as industry-specific characteristics, in order to provide rich insights into firms' decisions and behaviors. Our study provides a cross-sectional snapshot of the green IT practices of major Taiwanese firms; future studies can benefit from a longitudinal design capable of investigating the evolving roles of key determinants over time; this is essential as firms, industries, and governments become increasingly matured and experienced in green IT practices. Furthermore, although our model can explain a significant portion of the variances in firms' green IT practices, future research should consider and test additional antecedents; for example, senior executives' attitudes and organization-level assessments could be relevant and warrant our attention.

Appendix D: Question Items Used in the Study

Global Environmental Awareness (Babiak & Trendafilova, 2011; Cohen, 2010; Franzen, 2003)

GA-1: People around the world are increasingly concerned about the sustainability of our environment.
GA-2: People now talk about environment issues more than before.
GA-3: People are more cautious about preserving the environment than before.
GA-4: People are willing to do what is right for the environment, even when they incur additional costs, spend more time, or pay more taxes.

Industry Norms (Babiak & Trendafilova, 2011; Stern et al., 1985)

IN-1: Firms in our industry care about environmental issues.
IN-2: Firms in our industry are conscious about selecting appropriate methods, technologies, or practices that can reduce their damages to the environment.
IN-3: Firms in our industry share information and practices, formally or informally, for environmental protection.
IN-4: Our industry has a moral obligation to keep its products and services from harming the environment.

Laws and Government Regulations (Chien & Shih, 2007)

LR-1: Our government makes firms responsible for damages to the environment (such as pollution) by establishing laws governing waste handling and potential pollution to the environment.
LR-2: Our government policies require more green practices by firms.
LR-3: Government regulations demand firms to practice in ways that foster environmental sustainability.
LR-4: Overall, the laws and regulations by our government favor environmental friendliness.

Stakeholders' Attitudes (Mostafa, 2007)

SA-1: Our investors highly emphasize our being conscious about environmental preservation.
SA-2: Our key customers reward us for preserving the environment in our operations and processes.
SA-3: Overall, our stakeholders have favorable attitudes towards green practices and operations.

Competitors' Green Practice (Zhu & Sarkis, 2004)

CG-1: Our main competitors emphasize the use of reusable, recyclable or recoverable materials, parts or products.
CG-2: Overall, our competitors highly value green operations and practices in key aspects of their business.
CG-3: Our key competitors perform tight environmental audits of their suppliers.

Green IT Practices (Hedwig et al., 2009; Molla et al., 2009)

GIT-1: We consider environmental factors when designing our IT infrastructure, systems, data centers, and web sites.
GIT-2: We audit the power efficiency of our information systems/technologies routinely.
GIT-3: We always give high priority to IT vendors that are environmentally friendly, such as offering recycling program or take-back options.
GIT-4: We purchase energy-efficient IT products, such as Energy Star, 80 PLUS power supply, and EPEAT (Electronic Product Environmental Assessment Tool).

References

Ambec, S., & Lanoie, P. 2008. Does it pay to be green? A systematic overview. ***Academy of Management Perspectives***, 22(4): 45-62.

Avellaneda, C.N. 2009. Combinative effects of innovation types and organizational performance: A longitudinal study of service organizations. ***Journal of Management Studies***, 46(4): 650-675.

Babiak, K., & Trendafilova, S. 2011. CSR and environmental responsibility: Motives and pressures to adopt green management practices. ***Corporate Social Responsibility and Environmental Management***, 18(1): 11-24.

Banerjee, S.B. 2002. Corporate environmentalism: The construct and its measurement. ***Journal of Business Research***, 55(3): 177-191.

Bansal, P., & Roth, K. 2000. Why companies go green: A model of ecological responsiveness. ***Academy of Management Journal***, 43(4): 717-736.

Berman , S.L., Wicks, A.C., Kotha, S., & Jones, T.M. 1999. Does stakeholder orientation matter? The relationship between stakeholder management models and firm financial performance. ***Academy of Management Journal***, 42(5): 488-506.

Bohlen, G., Schlegelmilch, B.B., & Diamantopoulos, A. 1993. Measuring ecological concern: A multi-construct perspective. ***Journal of Marketing Management***, 9: 415-430.

Boudreau, M.-C., Chen, A., & Huber, M. 2007. Green IS: Building sustainable business practices, in R.T. Watson (ed.), ***Information Systems***. Atlanta, GA: The Global Text Project (pp. 1-15).

Brouthers, K.D. 2002. Institutional, cultural and transaction cost influences on entry mode choice and performance. ***Journal of International Business Studies***, 33(2): 203-221.

Brislin, R.W., Lonner, W.J., & Throndike, R.M. 1973. ***Cross-Cultural Research Methods***. NewYork: John Wiley & Sons,.

Bucholz, R.A. 1991. Corporate responsibility and the good society: From economics to ecology; factors which influence corporate policy decisions. ***Business Horizons***, 34(4): 1-19.

Buckley, P.J., Pass, C.L., & Prescott, K. 1988. Measures of international competitiveness: A critical survey. ***Journal of Marketing Management***, 4(2): 175-200.

Butler, T. 2011. Compliance with institutional imperatives on environmental sustainability: Building theory on the role of Green IS. ***Journal of Strategic Information Systems***, 20(1): 6-26.

Butler, T., & Daly, M. 2009. Environmental responsibility and green IT: An institutional perspective. ***ECIS 2008 Proceedings***. Paper 10.

Campbell, J. 2007. Why would corporations behave in socially responsible ways? An institutional theory of corporate social responsibility. ***Academy of Management Review***, 32(3): 946-967.

Chamberlin, B. 2012. Sustainability & green IT - A horizonwatching trend report. http://www.slideshare.net/HorizonWatching/sustainability-green-it-a-horizonwatching-trend-report (Accessed at May 1, 2012).

Chen, A.J., Watson, R.T., Boudreau, M.-C., & Karahanna, E. 2009. Organizational adoption of green IS & IT: An Institutional perspective. ***ICIS 2009 Proceedings***. Paper 142.

Chen, M.-J., Smith, K.G., & Grimm, C.M. 1992. Action characteristics as predictors of competitive responses. ***Management Science***, 38(3): 439-455.

Chen, M.-J., Su, K.-H., & Tsai, W. 2007. Competitive tension: The awareness-motivation-capability perspective. ***Academy of Management Journal***, 50(1): 101-118.

Chien , M.K., & Shih, L.H. 2007. An empirical study of the implementation of green supply chain management practices in the electrical and electronic industry and their relation to organizational performances. ***International Journal of Environment Science and Technology***, 4(3): 383-394.

Chin, W.W. 2010. How to write up and report PLS analyses. In V. E. Vinzi et al., (eds.), ***Handbook of Partial Least Squares: Concepts, Methods and Applications***. Berlin: Spinger (pp. 655-690).

Chou, D.C., & Chou, A.Y. 2012. Awareness of green IT and its value model. ***Computer Standards & Interfaces***, 34(5), 447-451.

Cohen, M.J. 2010. Ecological modernisation, environmental knowledge and national character: A preliminary analysis of the Netherlands. ***Environmental Politics***, 9(1): 77-106.

CompTIA. 2011. Green IT trending upward as a priority for organizations, CompTIA Study Finds. http://www.comptia.org/news/pressreleases/11-04-19/Green_IT_Trending_Upward_as_a_Priority_for_Organizations_CompTIA_Study_Finds.aspx (Accessed at April 19, 2012).

Corbett, C.J., & Kirsch, D.A. 2001. International diffusion of ISO 14000 certification. ***Production and Operation Management***, 10(3): 327-342.

Costello, T. 2011. 2011 IT tech and strategy trends. ***IT Professional***, 13(1): 64, 61-63.

Dedrick, J. 2010. Green IS: Concepts and issues for information systems research. ***Communications of the Association for Information Systems***, 27(1): 173-184.

Delmas, M., & Toffel, M.W. 2004. Stakeholders and environmental management practices: An institutional framework. ***Business Strategy and the Environment***, 13(4): 209-222.

Derfus, P.J., Maggitti, P.G., Grimm, C.M., & Smith, K.G. 2008. The red queen effect: Competitive actions and firm performance. ***Academy of Management Journal***, 51(1): 61-80.

Diekmann, A., & Franzen, A. 1999. The wealth of nations and environmental concern. ***Environment and Behavior***, 31: 540-549.

DiMaggio, P.J., & Powell, W,W. 1983. The iron cage revisited: Institutional isomorphism and collective rationality in organizational fields. ***American Sociological Review***, 48: 147-160.

Donaldson, T. 1982. Corporations and Morality. Englewood Cliffs, NJ: Prentice Hall.

Donaldson, T. 1989. ***The Ethics of International Business***. New York: Oxford University Press.

Donaldson, T., & Dunfee, T.W. 1994. Toward a unified conception of business ethics: Integrative social contracts theory. ***The Academy of Management Review***, 19(2): 252-284.

Dunfee, T.W. 2006. A critical perspective of integrative social contracts theory: Recurring criticisms and next generation research topics. ***Journal of Business Ethics***, 68(3): 303-328.

Dunfee, T.W., Smith, N.C., & Ross, W.T. 1999. Social contracts and marketing ethics. ***Journal of Marketing***, 63(3): 14-32.

Elliot, S. 2011. Transdisciplinary perspectives on environmental sustainability: A resource base and framework for IT-enabled business transformation. ***MIS Quarterly***, 35(1): 197-236.

Elliot, S., & Binney, D. 2008. Environmentally sustainable ICT: Developing corporate capabilities and an industry-relevant IS research agenda. ***PACIS 2008 Proceedings***. Paper 209.

Fornell, C., & Larcker, D.F. 1981. Evaluating structural equation models with unobservable variables and measurement error. ***Journal of Marketing Research***, 18(1): 39-50.

Franzen, A. 2003. Environmental attitudes in international comparison: An analysis of the ISSP surveys 1993 and 2000. ***Social Science Quarterly***, 84(2): 297-308.

Freeman, R.E. 1984. ***Strategic Management: A Stakeholder Approach***. Englewood Cliffs, NJ: Prentice-Hall.

Gadenne, D.L., Kennedy, J., & McKeiver, C. 2009. An empirical study of environmental awareness and practices in SMEs. ***Journal of Business Ethics***, 84, 45-63.

Gartner Research Group (2007. Green IT: The New Industry Shock Wave.

Gartner Research Group (2010. Gartner Releases Top 10 Technologies for 2009. http://www.gartner.com/it/page.jsp?id=1210613 (Accessed at June 8, 2012).

Gefen D, Straub, D, & Boudreau M. 2000. Structural equation modeling and regression: guidelines for research practice. ***Communications of the Association for Information Systems***, 4(7): 1-76

Godfrey, R. 1998. Ethical purchasing: Developing the supply chain beyond the environment. In Russel, T. (ed.) ***Greener Purchasing: Opportunities and Innovations***. Sheffield, England: Greenleaf Publishing (pp.244-251).

González, P.d.R. 2005. Analyzing the factors influencing clean technology adoption: A study of the Spanish pulp and paper industry, ***Business Strategy and the Environment***, 14(1): 20-37.

Gunningham, N., & Rees, J. 1997. Industry self-regulation: An institutional perspective. ***Law & Policy***, 19(4): 363-414.

Hedwig, M., Malkowski, S., & Neumann, D. 2009. Taming energy costs of large enterprise systems through adaptive provisioning, ***ICIS 2009 Proceedings***. Paper 140.

Hoffman, A.J. 1999. Institutional evolution and change: Environmentalism and the U.S. chemical industry. ***Academy of Management Journal***, 42, 351-371.

Jenkin, T.A., Webster, J., & McShane, L. 2011. An agenda for 'green' information technology and systems research. ***Information and Organization***, 21(1): 17-40.

Jenkins, H., & Yakovleva, N. 2006. Corporate social responsibility in the mining industry: Exploring trends in social and environmental disclosure. ***Journal of Cleaner Production***, 14(3-4), 271-284.

Jennings, P., & Zandbergen, P. 1995. Ecologically sustainable organisations. ***Academy of Management Review***, 20(4): 1015-1052.

Johnston, D.A., & Linton, J.D. 2000. Social networks and the implementation of environmental technology. ***IEEE Transactions on Engineering Management***, 47(4): 465-477.

Lee, S.-Y. 2008. Drivers for the participation of small and medium-sized suppliers in green supply chain initiatives. ***Supply Chain Management***, 13(3): 185-198.

Lempert, R.J., & Schlesinger, M.E. 2000. Robust strategies for abating climate change. ***Climatic Change***, 45(3-4): 387-401.

Lindell, M.K., & Whitney, D.J. 2001. Accounting for common method variance in cross-sectional research designs. ***Journal of Applied Psychology***, 86(1): 114-121.

Loeser, F., Erek, K., Schmidt, N., Zarnekow, R., & Kolbe, L.M. 2011. Aligning green IT with environmental strategies: Development of a conceptual framework that leverages sustainability and firm competitiveness. ***AMCIS 2011 Proceedings***. Paper 222.

Logsdon, J.M., & Yuthas, K. 1997. Corporate social performance, stakeholder orientation, and organizational moral development. ***Journal of Business Ethics***, 16(12/13): 1213-1226.

Marcus, A.A., & Fremeth, A.R. 2009. Green management matters regardless. ***Academy of Management Perspectives***, 23(3): 17-26.

McLaren, T.S., Manatsa, P.R., & Babin, R. 2010. An inductive classification scheme for green IT initiatives. ***AMCIS 2010 Proceedings***. Paper 404.

Meijer, G.I. 2010. Cooling energy-hungry data centers. ***Science***, 328(5976): 318-319.

Melnyk, S.A., Sroufe, R.P., & Calantone, R. 2003. Assessing the impact of environmental management systems on corporate and environmental performance. ***Journal of Operations Management***, 21(3): 329-351.

Melville, N.P. 2010. Information systems innovation for environmental sustainability. ***MIS Quarterly***, 34(1): 1-21.

Miller, D., & Chen, M. 1996. Nonconformity in competitive repertoires: A sociological view of markets. ***Social Forces***, 74(4): 1209-1234.

Molla, A. 2008. GITAM: A model for the adoption of green IT. ***ACIS 2008 Proceedings***. Paper 64.

Molla, A. 2009. Organizational motivations for green IT: Exploring green IT matrix and motivation models. ***PACIS 2009 Proceedings***. Paper 13.

Molla, A., Cooper, V., & Pittayachawan, S. 2009. IT and eco-sustainability: Developing and validating a green IT readiness model. ***ICIS 2009 Proceedings***. Paper 141.

Mostafa, M.M. 2007. Gender differences in egyptian consumers' green purchase behaviour: The effects of environmental knowledge, concern and attitude. ***International Journal of Consumer Studies***, 31(3): 220-229.

Murugesan, S. 2008. Harnessing green it: principles and practices. ***IT Professional***, 10(1): 24-33.

Naffziger, D.W., Ahmed, N.U., & Montagno, R.V. 2003. Perceptions of environmental consciousness in U.S. small business: An empirical study. ***SAM Advanced Management Journal***, 68(2): 23-32.

Norman, W., & MacDonald, C. 2004. Getting to the bottom of “triple bottom line.” ***Business Ethics Quarterly***, 14(2): 243-262.

Nunnally, J. 1978. ***Psychometric Theory***. New York: McGraw-Hill.

Olson, E.G. 2008. Creating an enterprise-level "green" strategy. ***The Journal of Business Strategy***, 29(2): 22-30.

Podsakoff, P.M., & Organ, D.W. 1986. Self-reports in organizational research: Problems and prospects. ***Journal of Management***, 12(4): 531-544.

Porac, J.G., & Thomas, H. 1990. Taxonomic mental models in competitor definition. ***Academy of Management Review***, 15(2): 224-240.

Porter, M.E., & Kramer, M.R. 2006. Strategy and society: The link between competitive advantage and corporate social responsibility, ***Harvard Business Review***, 84(12): 78-92.

Prandelli, E., Sawhney, M.S., & Verona, G. 2008. Collaborating with Customers to Innovate: Conceiving and Marketing Products in the Networking Age. Cheltenham. UK: Edward Elgar Publishing Limited.

Rao, P., & Holt, D. 2005. Do green supply chains lead to competitiveness and economic performance? ***International Journal of Operations & Production Management***, 25(9): 898-916.

Rashid, N.R.N.A. 2009. Awareness of eco-label in Malaysia’s green marketing initiative. ***International Journal of Business and Management***, 4(8): 132-137.

Reid, E.M., & Toffel, M.W. 2009. Responding to public and private politics: Corporate disclosure of climate change strategies. ***Strategic Management Journal***, 30(11): 1157-1178.

Ruth, S. 2009. Green IT-more than a three percent solution? ***IEEE Internet Computing***, 13(4): 74-78.

Sarkis, J., Gonzalez-Torre, P, & Adenso-Diaz, B. 2010. Stakeholder pressure and the adoption of environmental practices: The mediating effect of training. ***Journal of Operations Management***, 28(2): 163-176.

Scott, W.R. 1992. ***Organizations: Rational, Natural, and Open Systems***. Englewood Cliffs, NJ: Prentice-Hall.

Scott, W.R. 2004. Institutional theory: Contributing to a theoretical research program. In K.G. Smith, and M.A. Hitt (eds.), ***Great Minds in Management: The Process of Theory Development***. Oxford University Press, Oxford, UK (pp. 460-484).

Scott, W.R., & Meyer, J. 1983. The organization of societal sectors. In J.W. Meyer and W.R. Scott (eds.), ***Organizational Environments: Ritual and Rationality***. Beverly Hills, CA: Sage (pp. 129-155).

Sheth, J.N., Sethia, N.K., & Srinivas, S. 2011. Mindful consumption: A customer-centric approach to sustainability. ***Journal of the Academy of Marketing Science***, 39(1): 21-39.

Shrivastava, P. 1995. Environmental technologies and competitive advantage. ***Strategic Management Journal***, 16(S1): 183-200.

Siegel, D.S. 2009. Green management matters only if it yields more green: An economic/strategic perspective. ***Academy of Management Perspective***, 23(3): 5-16.

Stern, P.C., Dietz, T., & Black, J.S. 1985. Support for environmental protection: The role of moral norms. ***Population and Environment***, 8(3/4): 204-222.

Suchman, M.C. 1995. Managing legitimacy: Strategic and institutional approaches. ***Academy of Management Review***, 20(3): 571-610.

Velte, T., Velte, A., & Elsenpeter, R. 2008. ***Green IT: Reduce Your Information System's Environmental Impact While Adding to the Bottom Line***. New York: McGraw-Hill.

Waddock, S. A., & Graves, S. 1997. The corporate social performance-financial performance link. ***Strategic Management Journal***, 18, 303-317.

Watson, R.T., Boudreau, M.-C., & Chen, A. 2010. Information systems and environmentally sustainable development: Energy informatics and new directions for the IS community. ***MIS Quarterly***, 34(1): 23-38.

Zhu, Q., Saikis, J., & Lai, K. 2008. Confirmation of a measurement model for green supply chain management practices implementation. ***International Journal of Production Economics***, 261-273.

Zhu, Q., & Sarkis, J. 2004. Relationships between operational practices and performance among early adopters of green supply chain management practices in Chinese manufacturing enterprises. ***Journal of Operations Management***, 22, 265-289.